(1)

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

NAVY/MARINE CORPS MANAGER'S DESKTOP GUIDE FOR CALS IMPLEMENTATION

SECOND EDITION

30 JUNE 1993

GUIDE CONTENTS

Best Available Copy

"The Navy's strong commitment to CALS is reinforced by the significant process and productivity that CALS initiatives are providing within the Navy infrastructure. CALS programs are on-line and working in today's Navy to produce improved weapons system designs, access more accurate and timely technical data, and reduce acquisition and logistics support costs.

In an era of declining budgets, CALS is most important in enhancing logistic support productivity to maintain operations and improve readiness. Our continued emphasis is on coordinating and further integrating CALS initiatives across the entire life cycle of technical data to achieve the synergy inherent in a network of distributed data."

J.B. Greene, Jr.
Rear Admiral, US Navy
Extracted from Rear Admiral Green's Welcome to CALS Expo '91 in the Navy CALS Expo '91 Brochure

Introduction

Computer-aided Acquisition and Logistic Support (CALS) is becoming a very important part of the Navy's business approach. The intent of CALS is to improve the timeliness, reduce the costs, and improve the quality of defense system acquisition and support. This goal is to be accomplished through the general adoption of a set of procedures and standards for the production, access, management, maintenance, and distribution of technical data in digital form. This goal will enable more effective creation, exchange, and use of data for defense systems and equipment. The first part of CALS, now being implemented, is focusing on phasing out paper document transfer where feasible, in favor of electronic file exchanges. A longer-term CALS objective is to develop integrated product data bases and create advanced engineering and manufacturing systems. The approach to CALS implementation will vary by program acquisition phase and by program type, size and duration.

This *Navy/Marine Corps Manager's Desktop Guide for CALS Implementation* compiles numerous specifications, manuals, and documents pertaining to CALS and the acquisition of digital technical data. This guide contains both background and working information about the use of CALS in the acquisition process. It also provides a compilation of the Navy's direction and intent for the incorporation of CALS into defense system programs. Also included (Figure Intro-1) is a model for the Naval forces perspective of "CALS in the Acquisition Process." This model is included as a graphic on the cover of each document section with the relevant section highlighted within the process model. The intent of this Acquisition Process Model and this Desktop Guide is to assist you in providing synergy among CALS, the acquisition process, and the Navy's commitment to improving business processes.

For further questions, comments, or recommendations on this guide, write or call:

CALS Resource and Implementation Cooperative (RIC)
Naval Air Warfare Center Aircraft Division Indianapolis
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Indianapolis, IN 46219-2189
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Overview

1. **DoD 5000.2 (Part 6, Section N/Part 9, Section B)**

Part 6, Section N. of DoDI 5000.2 provides policies and procedures to establish a basis necessary to make effective use of CALS and related information technologies during the life cycle of defense systems and equipment. Part 9, Section B, of DoDI 5000.2 provides policies and procedures to establish a basis for an effective program for management of technical data and technical manuals.

2. **Acquisition Information Strategy**

The Acquisition Information Strategy provides information on CALS, developed in accordance with DoDI 5000.2, that is to be included in acquisition documents.

3. **JCMO/DoD Acquisition Guide for Implementation of CALS**

The purpose of this acquisition guide is to assist the acquisition manager and supporting staff in implementing CALS during the acquisition process -- from acquisition strategy to contract award. This guide will assist in contracting for digital data products and services by focusing on the development of the acquisition strategy and solicitation documentation with sound CALS requirements.

4. **Guide for Developing a CALS GCO**

This document provides guidance to acquisition managers and others who have an interest in applying CALS to the acquisition of data products in support of weapons systems. This guidance in the form of a Government Concept of Operation (GCO), identifies typical user's needs for technical data throughout all life cycle activities of weapons systems management, design, manufacture, and support functions.

5. **Sample Statement of Work Language**

This generic Statement of Work (SOW) provides sample language to assist in the implementation of CALS for an acquisition program. This CALS-related language should be used in developing the functional requirements within each applicable section of the Request for Proposal (RFP).

6. **Applying CALS to the Creation, Management, and Use of Technical Data Packages**

This document is intended to provide the acquisition manager with an overview of Navy/Marine Corps business practices for the creation, management, and use of technical data packages (TDPs) in a CALS environment. The document also provides information on various digital data media, format, and content options available for obtaining TDPs.

7. **Applying CALS to the Creation, Management, and Use of Technical Manuals**

This document is intended to provide the acquisition manager with an overview of Navy/Marine Corps business practices for the creation, management, and use of technical manuals (TMs) in a CALS environment. The document also provides information on various digital data media, format, and content options available for obtaining TMs.

8. **Applying CALS to the Logistic Support Analysis Process**

This document is intended to provide the acquisition manager with an overview of Navy/Marine Corps Business practices for the creation, management, and use of ILS and LSAR data in a CALS environment. The document also provides information on various digital data media, format, and content options available for obtaining ILS and LSAR data.

9. **CALS Standards Overview**

This document presents a brief summary of the initial CALS standards including their purpose, current status, and implementation issues. It concentrates on the CALS specifications implemented by MIL-STD-1840, Automated Interchange of Technical Information.

10. **Program CALS Self Assessment Checklist**

This checklist provides information to be addressed when developing and updating acquisition/program requirements documents in a CALS environment over the complete life cycle of a weapons system program. Key areas include: program documentation; technical manuals; technical data (drawings); logistics support analysis; supply support; and manpower, personnel, and training.

11. **Points-of-Contact Listing**

This section provides information on key personnel in the Navy/Marine Corps CALS program that can provide assistance/direction in the development and implementation of acquisition guidance in the CALS environment.

12. **Infrastructure Requirements For The Creation, Management, And Use of Digital Data**

This Section provides information on developing and updating hardware, software, and network program requirements in a CALS environment.

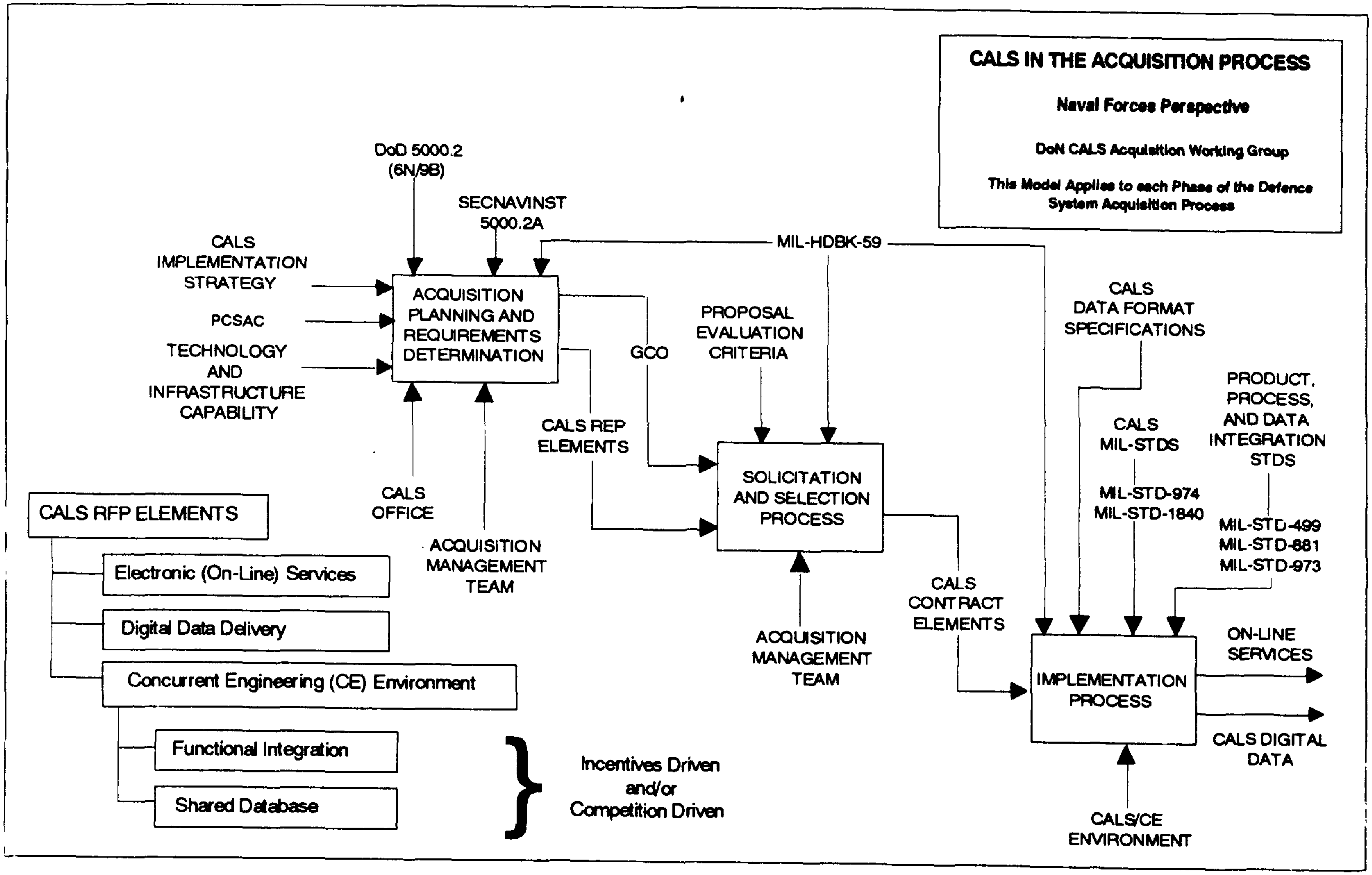

FIGURE INTRO-1: CALS in the Acquisition Process

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COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

SECTION 1

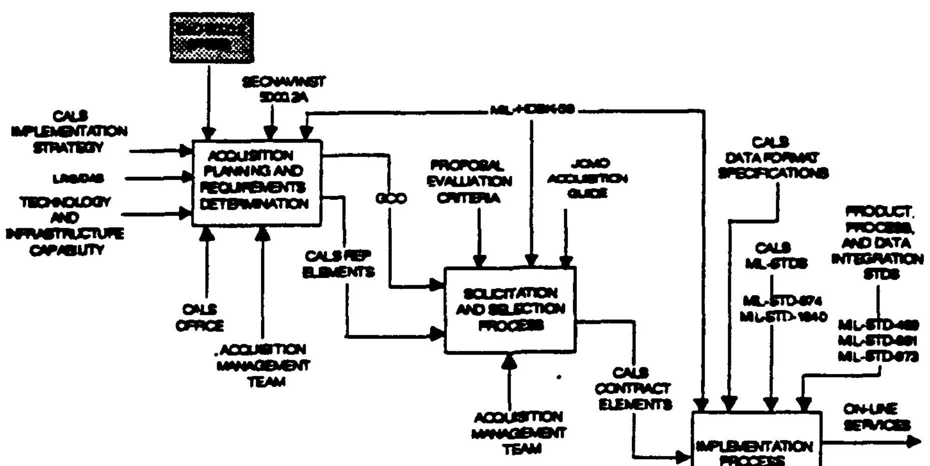
DoDI 5000.2
(Part 6, Section N/Part 9, Section B)

CALS IN THE ACQUISITION PROCESS

Naval Forces Perspective

DoN CALS Acquisition Working Group

This Model Applies to each Phase of the Defence System Acquisition Process



- CALS RFP ELEMENTS
  - Electronic (On-Line) Services
  - Digital Data Delivery
  - Concurrent Engineering (CE) Environment
    - Functional Integration
    - Shared Database

} Incentives Driven and/or Competition Driven

Part 6

Section N

COMPUTER-AIDED ACQUISITION AND LOGISTICS SUPPORT

References:

a. Deputy Secretary of Defense Memorandum, "Computer-Aided Acquisition and Logistics Support," August 5, 1988 (canceled)
b. MIL-STD-1840, " Automated Interchange of Technical Information"
c. MIL-STD-1556, "Government-Industry Data Exchange Program"
d. MIL-HDBK-59, "Computer-Aided Acquisition and Logistics Support Program Implementation Guide"

1. PURPOSE

a. This section supercedes Deputy Secretary of Defense Memorandum "Computer-Aided Acquisition and Logistics Support" (reference (a)).

b. These policies and procedures establish the basis for making greater use of computer aided information technologies that enable process improvements in design, manufacturing, and life-cycle support of defense systems and equipment.

2. POLICIES

In general, preference shall be given to contractor information services and online access instead of data deliverables. Where data delivery is required, preference shall be given to delivery in machine-readable digital form rather than paper wherever feasible.

3. PROCEDURES

a. Proposals. Acquisition plans and solicitations will require specific proposals, including costs and schedule, for:

1) Integration of contractor technical information systems and processes for engineering, manufacturing, and logistic support;

2) Authorized Government access to contractor data bases; and

3) Delivery of technical information in digital form using computer aided acquisition and logistics support standards contained in MIL-STD-1840 (reference (b)).

b. Shared Models and Data Bases

1) Contractors should be required to develop integrated, shared data base environments consisting of analysis tools, consistent integrated databases, and engineering design, manufactureing and logistics processes designed to utilize digital information.

2. Contractors should use computer aided design, engineering, and manufacturing (CAD/CAE/CAM) methods to support design integration through shared product and process models and data bases.

c. Management Structure. A comprehensive technical information management architecture to include supporting data dictionary and directory services should be developed to:

1) Manage configuration of the entire technical information and planning databases;

2) Integrate planning information into its respective technical information source database;

3) Provide traceability and audibility of technical information relating to the weapon system, its components, and any changes affecting them; and

4) Trace configuration changes from design to logistics products and vice-versa.

5) Exploit opportunities to obtain cost savings by retrofitting digital information technology into deployed weapon systems.

d. Information Services. Contractor integrated technical information services should be developed to include procedures, processes, specifications, and software applications for the generation, protection, integration, storage, exchange, and online access of digital data by the Government and associated contractors.

e. Government-Industry Data Exchange Program (GIDEP). The Government-Industry Data Exchange Program is the DoD program that provides, without charge, an unclassified data base of parts problems, reliability, diminishing manufacturing resources, and metrology information.

1) The Government-Industry Data Exchange Program is described in MIL-STD-1556 (reference (c)).

2) The Government-Industry Data Exchange Program should be used by both program offices and contractors.

f. Access and Delivery Alternatives. MIL-HDBK-59 (reference (d)) provides technicalguidance for selecting among information access and delivery alternatives. Final decisions on implementation of contractor proposals will be based on the productivity and quality improvements expected in contractor team operations (prime, subcontractors, suppliers) and Government operations.

1) Technical data that are required as deliverables, including technicalmanuals, engineering data, and logistics support analysis data, should be required to be prepared and delivered in digital form unless clear and convincing analysis shows this not to be cost-effective when assessed across the life cycle.

2) The computer aided acquisition and logistics support standards in MIL-STD-1840 (reference (b)) will be applied for digital data deliverables.

4. RESPONSIBILITIES AND POINTS OF CONTACT

The matrix below identifies the offices to be contacted for additional information on this section. The full titles of these offices may be found in Part 14 of this Instruction.

DoD Component	Points of Contact	
	General	Specific
OSD	ASD (P&L)	DASD (PR)/CALS
Dept. of Army	ASA (IL&E)	SAILE-LOG
Dept of Navy	ASN (RDA)	DCNO (OP-04) HQMC/I&L
Dept of Air Force	SAF (AQK	AF/LE-I

PART 9

SECTION B

TECHNICAL DATA MANAGEMENT

References:

a. DoD Instruction 5010.12, "DoD Technical Data Management Program," January 23, 1989 (canceled)
b. DoD Instruction 4151.9, "DoD Technical Manual Program Management," January 3, 1989 (canceled)
c. DoD 5010.12-L, "Acquisition Management Systems and Data Requirements Control List (AMSDL)," reissued Semi-Annually in April and October, authorized by this Instruction
d. DoD 5025.1-M, "Department of Defense Directives System Procedures," December 1990, Authorized by DoD Directive 5025.1, "Department of Defense Directives System," December 23, 1988
e. Title 10, United States Code, Section 2302, "Definitions"
f. MIL-STD-1840, "automated Interchange of Technical Information"
g. MIL-HDBK-59, "Computer-Aided Acquisition and Logistics Support Program Implementation Guide"
h. Public Law 96-511, "Paperwork Reduction Act of 1980"
i. Federal Acquisition Regulation (FAR), Part 27, "Patents, Data, and Copyrights"
j. Defense Federal Acquisition Regulation Supplement (DFARS), Part 227, "Patents, Data, and Copyright"
k. MIL-STD-1806, "Marking Technical Data Prepared by or for The Department of Defense"
l. DoD Directive 5200.21, "Dissemination of DoD Technical Information," September 27, 1979
m. DoD-STD-963, "Data Item Descriptions (DIDs), Preparation of"
n. DoD-STD-1700, "Data Management Program"
o. "Technical Data Package, General Specifications for"

1. PURPOSE

a. This section replaces DoD Instruction 5010.12, " DoD Technical DataManagement Program": and DoD instruction 4151.9, " DoD Technical Manual Program Management" (references (a) and (b)), which have been canceled.

b. These policies and procedures establish the basis for an effective program for management of technical data and technical manuals. These policies and procedures do not apply to:

1) Technical data for cryptologic activities,

2) Technical manuals for nuclear weapon systems supported by publications under the Joint Nuclear Weapons Publications System, or

3) Data submitted by an offerer in response to a request for proposal (RFP).

c. This section authorizes the Assistant Secretary of Defense (Production and Logistics) to publish DoD 5010.12-L, "Acquisition Management Systems and Data Requirements Control List (AMSDL)" (reference (c)) and DoD 5010.12-M, "Procedures for the Acquisition and Management of Technical Data" in accordance with DoD 5025.1-M, "Department of Defense Directives System Procedures" (reference (d)).

2. POLICIES

a. Technical data, is defined in Title 10, United States Code, Section 2302, "Definitions (reference (e)) as recorded information (regardless of the form or method of the recording) of a scientific or technical nature (including computer software documentation) relating to supplies procured by an agency. Technical data does not include computer software or financial, administrative, cost or pricing, or management data or other information incidental to contract administration.

1) Technical data is required to define and document an engineering design or product configuration (sufficient to allow duplication of the original items) and is used to support production, engineering, and logistics activities.

2) A technical data package shall include all engineering drawings, associated lists, process descriptions, and other documents which define the physical geometry, material composition, performance characteristics, manufacture, assembly, and acceptance test procedures.

3) Technical data which provides instructions for the installation, operation, maintenance, training, and support of a system or equipment can be formatted into a technical manual.

a) A technical manual normally includes operation and maintenance instructions, parts lists or parts breakdown, and related technical information or procedures exclusive of administrative procedures.

b) This data may be presented in any form (e.g. hard copy, audio and visual displays, magnetic tape, disks, or other electronic devices).

c) Technical orders that meet the criteria of this definition may also be classified as technical manuals.

b. The DoD Component having management responsibility for an item shall ensure that the

Government has complete access to the data necessary to support the essential requirements of all users throughout the item's life cycle. This access may be achieved by:

1) Procuring, storing, and maintaining the necessary data in a Government data repository: or

2) Procuring access to the data through a contractor integrated technical information service (see Section 6-M).

3. PROCEDURES

a. Establishing Data Requirements

1) User data requirements will be established by use of a data call to all potential users.

a) A data requirements review board will be established to review data call recommendations and advise the Program Manager.

b) A data requirements review board will be convened before issuing a solicitation for any acquisition having a potential cost of $5 million or more.

2) Only the minimum data needed to permit cost-effective support ofresearch, development, production, cataloging, provisioning, training, operation, maintenance, and related logistics functions over the life cycle of the item will be acquired.

a) When the production contract for a single design is to be competed, product drawings and associated lists must be delivered by the end of Phase II, Engineering and Manufacturing Development.

b) Production contracts must include product drawings and associated lists for items that will be reprocured or manufactured in-house. When appropriate, the data package will include information suitable to compete replenishment of subtier spare parts including part level acceptance test procedures.

3) Standard data item descriptions (DIDs) that exceed the requirements of the data needed must be tailored. Tailoring maybe accomplished to:

a) Accept contractor format, or

b) Reduce the scope through deletion or selection of existing words, paragraphs, or sections.

4) Contract provisions must ensure that contractors and subcontractors prepare and update technical data packages as an integral part of their design, development, and production effort and must define the contractor's responsibility for accuracy and completeness of technical data packages and technical manuals. All technical data and technical manuals will be updated to reflect approved design changes and made available concurrent with the implementation of the change.

5) Data should be ordered in contractor format unless the Government format is necessary or more cost-effective. Maximum use will be made of commercial technical manuals, or their modifications, that meet DoD Component requirements.

   a) Contract deliverable data will be prepared and used in digital form unless it is not cost-effective for the Government. Maximum use should be made of available contractor automated data bases. Data to be delivered in digital form will comply with computer aided acquisition and logistics support (CALS) initiatives and MIL-STD-1840 (reference (f)). Refer to MIL-HDBK-59 (reference (g)) for guidance in selecting the specific digital data.

   b) When options are established for delivery of digital data, the program office will ensure that all the recipients of the digital data have the necessary capability to receive, store, and maintain the data. Where operational units are recipients, the system design should include the necessary capability to receive, store, and display the data.

   c) Technical manuals must be written to the reading and skill levels of the people for whom they are intended to ensure that the target audience understands the technical manual text or text-graphics combination.

6) Logistics support analysis data will be used to the maximum extent to define and develop source data for technical manuals.

b. Planning for New Technical Manuals. Plans will be developed for each new group of technical manuals supporting a weapon system, weapon system component, or support equipment to ensure the technical accuracy and adequacy of technical manual content. These plans will provide for:

1) The optimum number and types of conventional publications and other media such as audiovisual systems, tape, disc, or other electronic devices;

2) Technical manual availability in:

   a) Preliminary form using contractor in-house manuals and repair and test documentation, as practicable, until the design is stable, and

   b) Final form for the programmed operational date for the equipment or system, except for materiel under contractor support.

3) Clear definition of contractor's responsibility for accuracy and completeness of technical manuals and contractor and DoD Component's participation in validation and verification; and

4) Review of technical manual plans during in-process reviews to ensure timely completion of validation and verification in time to support realistic operational test and evaluation.

c. Data Acquisition Documents. Specific requirements for the preparation of deliverable data or for record keeping are to be documented in specifications, standards, and data item descriptions, collectively known as data acquisition documents.

1) Data requirements in solicitations and contracts will be selected from data item descriptions listed in the Acquisition Management Systems and Data Requirements Control List (reference (c)). Before being listed in the Acquisition Management Systems and Data Requirements Control List, new or revised data item descriptions will be reviewed by the Acquisition Management Systems and Data Requirements Control List clearance office in compliance with the requirements of Public Law 96-511, "Paperwork Reduction Act of 1980" (reference (h)).

2) A one-time data item description may be developed to define the content and format requirements of a data product if an appropriate data item description is not contained in the Acquisition Management Systems and Data Requirements Control List. One-time data item descriptions will be used on only one contract.

3) One-time data item descriptions will be approved in accordance with DoD Component procedures. A record of such approvals will be maintained within each DoD Component. An annual listing of approvals as of September 30 will be submitted to the Acquisition Management Systems and Data Requirements Control List clearance office no later than November 30 of each year.

4) Data item descriptions will not be used to delineate requirements for technical manuals for weapon systems, weapon systems components, or support equipment. These manuals will be acquired by line item and have an exhibit attached to the acquisition document. The acquisition of technical manual administrative and/or management data such as status reports, validation plan schedules, and manuals other than those to support a weapon system shall be acquired by Data ItemDescription.

d. Ordering, Delivery, Inspection, and Acceptance of Data. Data will be ordered, delivered, inspected, and accepted in accordance with the Federal Acquisition Regulation and Defense Federal Acquisition Regulation Supplement (references (i) and (j)).

e. Rights in Data. Acquisition of rights in technical data will be in accordance with the Federal Acquisition Regulation and Defense Federal Acquisition Regulation Supplement (references (i) and (j)).

f. Warranty of Data. Acquisition of data warranties will be in accordance with the Defense Federal Acquisition Regulation Supplement (reference (j)).

g. Distribution Statements on Technical Data. Technical data will be marked in accordance with the Defense Federal Acquisition Regulation Supplement (reference (j)) and MIL-STD-1806 (reference (k)) to denote the extent to which the data may be distributed without further approval of the controlling DoD office.

h. Data Repositories. Technical data packages, software media, and associated data will be received, inventoried, inspected, accepted, indexed, stored, and managed to provide maximum accessibility to DoD Components and to ensure that contractor data rights are protected.

1) DoD Component Heads will establish and maintain index entries for Military Engineering Data Assets Locator System (MEDALS). Data elements for those indices will be coordinated with other DoD Components to maximize the interchange of data assets.

2) An in-house technical manual inventory and index system will be established in each DoD Component to improve the management and exchange of technical manuals.

3) Arrangements may be made for the contractor to serve as a temporary repository for data in the development and production phases of a program. When the contractor serves as the data repository, the Government's rights to access and subsequent delivery through a deferred delivery plan will be protected.

i. Release of Data. To the maximum extent allowable by law and regulation, DoD Components will provide or make available requested data in accordance with applicable portions of the Federal Acquisition Regulation and Defense Federal Acquisition Regulation Supplement references (i) and (j).

j. Additional Guidance. Additional guidance is contained in DoD Directive 5200.21, MIL-STD-963, DoD-STD-1700, and MIL-T-3100 (references (1) through (o)).

4. RESPONSIBILITIES AND POINTS OF CONTACT

The matrix on the next page identifies the offices to be contacted for additional information on this section. The full titles of these offices may be found in Part 14 of this Instruction.

<u>DoD Component</u>	Points of Contact	
	General	Specific
OSD	ASD/(P&L)	DASD (PR)/SDM
Dept of Army	ASA (RDA)	SARD-ZP
Dept of Navy	ASN (RDA)	Dep, APIA
Dept of Air Force	AF/LE	AF/LEY
Other DoD Components	DLA	DLA-SE

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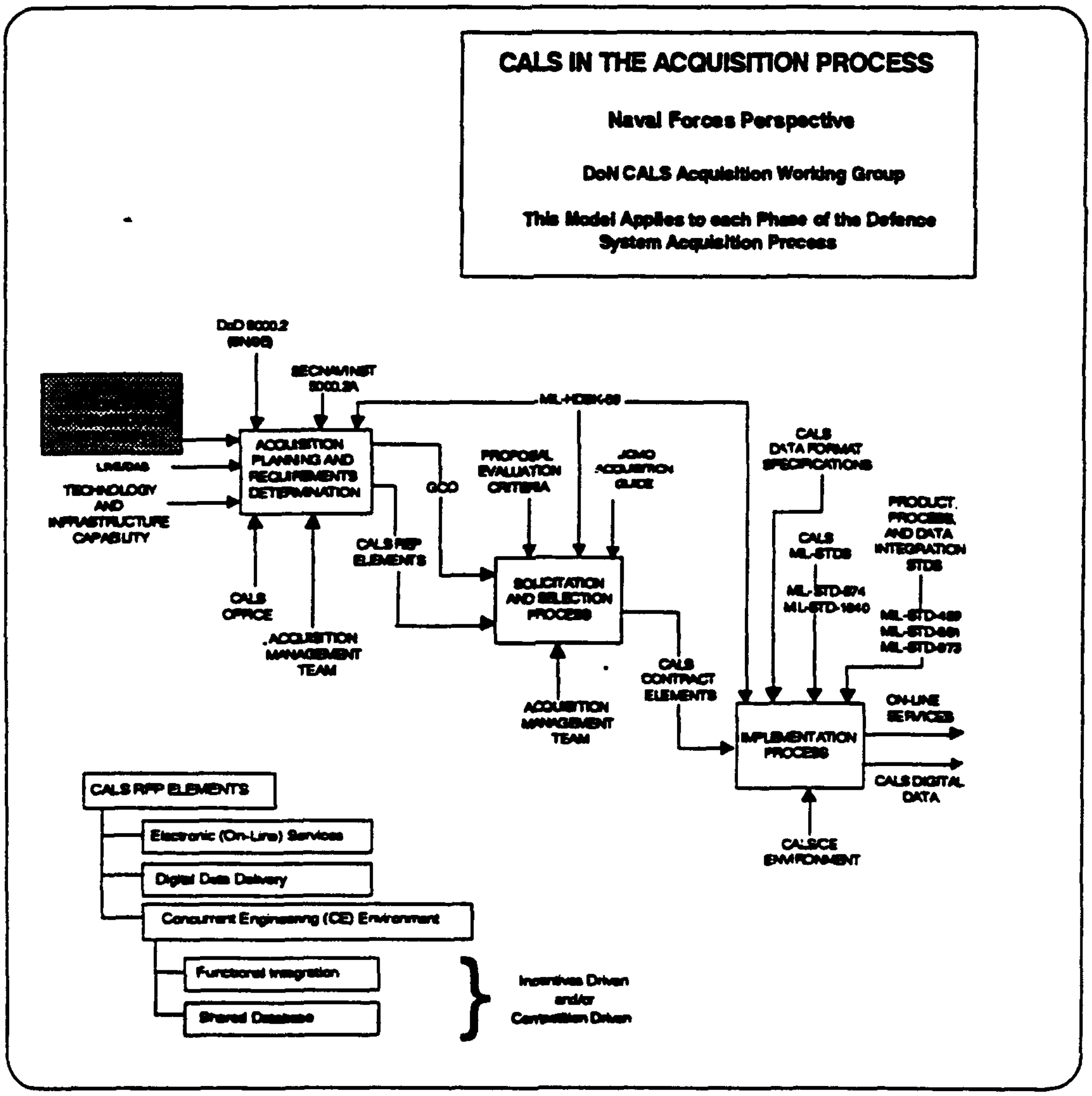
COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

SECTION 2

Acquisition Information Strategy



ACQUISITION INFORMATION STRATEGY

The following information on **Computer-aided Acquisition and Logistic Support (CALS)** is to be included in acquisition documents. These inputs are based upon the requirements of DoDI 5000.2, Part 6, Section N and are consistent with DoN strategy for CALS implementation.

The Integrated Program Summary (Appendix C of the Acquisition Strategy Report), should include the following statement:

"The [XXX] program will take advantage of existing and emerging automation and integration capabilities to establish a computer-based environment for creating, managing and storing data elements once for multiple applications across engineering, design, manufacturing and logistics functions and processes.

The Acquisition Plan (AP) should also include the following statement, applicable for the competitive System Dem/Val, E&MD and LRIP efforts:

"The [XXX] project intends to implement CALS initiatives to reduce life cycle costs, improve product quality, reduce program risk and reduce the schedule of the design, development and production. The technical information required in support of the project will be made accessible through on-line contractor integrated technical information (electronic) services; physical delivery of data required for sustaining support activities will be in accordance with approved CALS format standards and specifications. For contract data requirements not evaluated as cost-effectively delivered to the CALS standards/specifications, delivery will be in mutually agreeable digital formats. The digital formats for all data users and user systems will be determined cooperatively between the government and contractor using the Government Concept of Operations (GCO), developed by the government program office, as the basis for selection.

The draft and final RFPs will incorporate requirements for the offeror to address implementation of concurrent engineering and digital delivery/electronic access of program technical information. Significant weighting will be applied to the CALS element in source selection evaluation (not less than 10 percent of the total evaluation/rating). Offerors will be evaluated on their ability to provide integrated, shared data bases environments for engineering analysis, design, manufacturing and logistic processes; and their use of CAD/CAM/CAE methods, product models/data bases and simulation tools to improve product design, testing, manufacturing and support system development. The program will integrate specific program solutions with those developed by DoD/DoN infrastructure modernization initiatives and will implement, where value-effective, joint service CALS systems for the creation, management and use of digital technical information."

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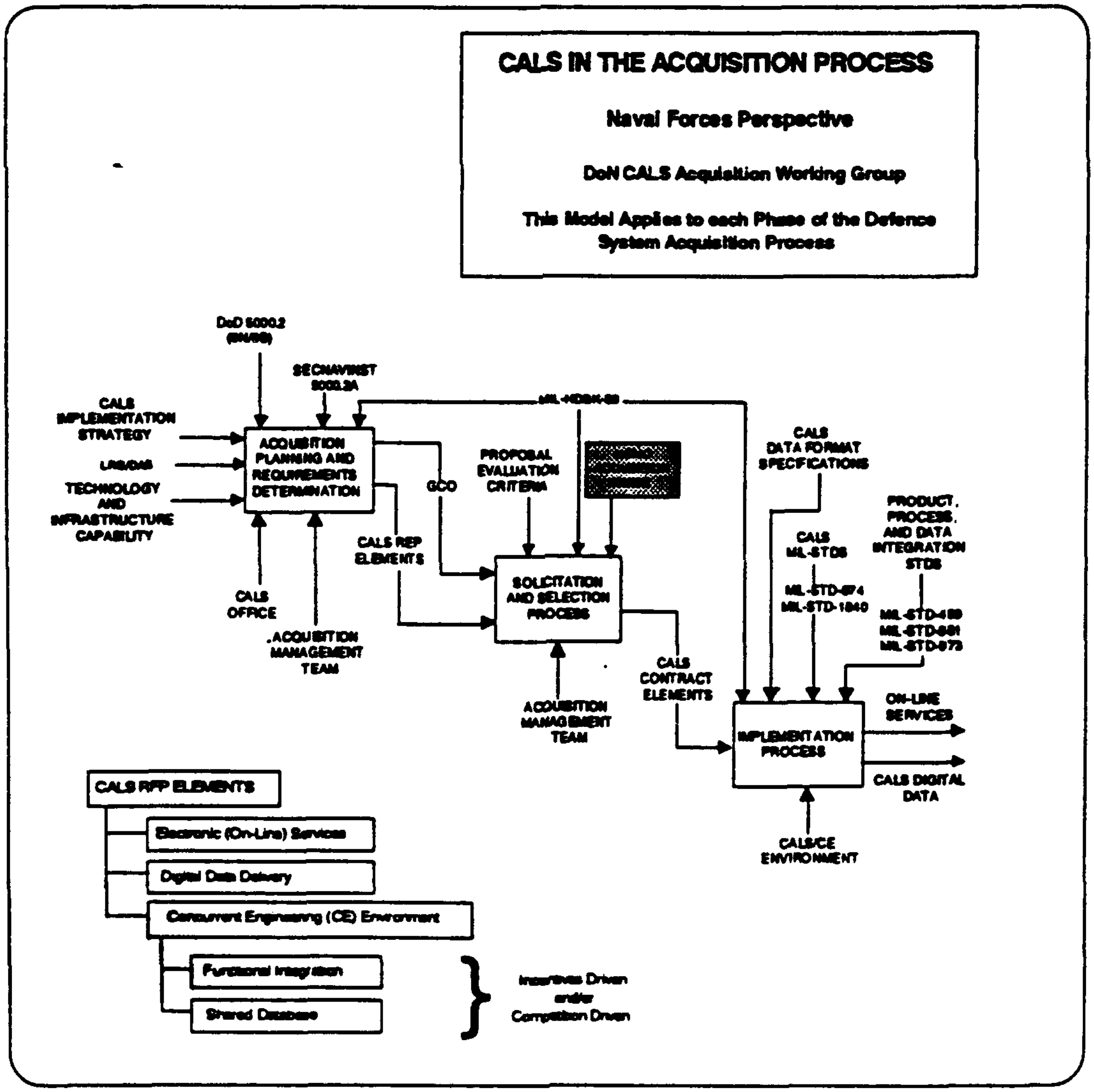
SECTION 3

JCMO DoD Acquisition Guide For Implementation Of CALS



NOTE

The following section has been retained within the Second Edition of the Navy/Marine Corps Manager's Desktop Guide for CALS Implementation for historical and general informational purposes only. Those areas where this section is in conflict with other portions of the Desktop Guide or other more current CALS documentation should be disregarded.

DEPARTMENT OF THE NAVY

JOINT CALS MANAGEMENT OFFICE (JCMO)
SKYLINE SIX, ROOM 310
5109 LEESBURG PIKE
FALLS CHURCH, VA 22041

Memo JCMO/00015
April 16, 1991

MEMORANDUM FOR THE DISTRIBUTION LIST[1]

Subj: Computer-Aided Acquisition and Logistics Support (CALS) Acquisition Guidance

Encl: (1) Department of Defense Acquisition Guide for Implementation of Computer-aided Acquisition and Logistics Support (CALS)

1. Despite the formal promulgation of the DoD initiative to transform the acquisition and life cycle support processes from a paper-intensive to a highly automated environment through CALS, a lack of specific targeted information is inhibiting the ability of the individual weapons systems program managers to implement CALS in a uniform, effective manner. As a result, the degree to which CALS has been implemented within individual acquisition has been variable.

2. Enclosure (1) is the product of a joint service initiative to respond to this deficiency. The Acquisition Guide contains an accumulation of information and guidance to improve implementation of CALS in weapon system acquisition programs. The information and guidance contained in enclosure (1) has been coordinated with the CALS Industry Steering Group (ISG) and is consistent with detailed technical methodologies included in MIL-HDBK-59A. The information was assembled from program managers who have successfully implemented and benefitted from CALS and from individual Service CALS advocates acting in a matrix support role to individual acquisition programs.

3. The guide provides information useful to personnel responsible for the acquisition and use of weapon system technical data. Its purpose is to assist acquisition managers in transitioning from paper-intensive processes to digital data delivery and access. It also supports the structuring of contact requirements to achieve integration of various contractor automated capabilities for design, manufacturing, and logistics support.

4. Throughout this guide, reference is made to the CALS handbook, MIL-HDBK-59A. This handbook is available from the National Institute of Standards and Technology, telephone (301) 975-6641/2 or the Navy Publications and Forms Center.

5. Addressees are encouraged to distribute and utilize enclosure (1) for use in developing CALS requirements within individual acquisitions. In order to maintain consistency and uniformity of the Acquisition Guide, the Joint CALS Management Office (JCMO) will coordinate any proposed revisions to this document with the services and DLA. Beneficial comments

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[1] This memo has been recreated and reprinted for the purposes of this **Manager's Guide to the Application of CALS.**

(recommendations, additions, deletions) and any pertinent data that may be of use in improving this document should be addressed to:

Joint CALS Management Office
Skyline Six, Suite 310
5109 Leesburg Pike
Falls Church, Va 22041

6. The following individuals may be contacted for additional information or clarification:

JCMO - Mr. Matt Weden (703) 756-0996
NAVY - Mr. Shawn McGill (703) 746-0840
ARMY - Mr. Mark Mohe (205) 842-2673
A.F. - Mr. Dennis Rogash (513) 255-7371
USMC - Capt Jeff Everest (703) 696-1180

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WASHINGTON, D.C. 20301
15 April 1991

Department of Defense
Acquisition Guide for Implementation of
Computer aided Acquisition and Logistic Support (CALS)

This acquisition guide was developed by the Department of Defense with the assistance of the military departments, defense agencies and industry.

Distribution Statement A. Approved for public release; distribution is unlimited.

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APPENDICES

1.0 Introduction

Computer-aided Acquisition and Logistic Support (CALS) is a strategy that enables more effective generation, exchange, use and management of defense systems and equipment technical information. These types of technical information include management, design/engineering, manufacturing, logistic support and operations information.

Within the emerging CALS environment, process improvements, such as Concurrent Engineering, are being applied to improve acquisition efficiency and product quality. CALS is an integral part of the acquisition process and is consistent with Acquisition Streamlining and Total Quality Management (TQM) efforts. The CALS target is an integrated information environment that will enable continuous process improvement.

1.1 Purpose/Scope

The purpose of this acquisition guide is to assist the DoD Acquisition Manager and supporting staff in implementing CALS during the acquisition process--from acquisition strategy to contract award. The material contained herein is advisory, not mandatory. Specific details, including technical and acquisition guidance, are available in MIL-HDBK-59A.

This guide will assist in contracting for digital data products and services by focussing on the development of an acquisition strategy and solicitation documentation with sound CALS requirements. Information is provided for developing requirements in the following areas:

a) Automation and integration of contractor technical information systems and functional processes;

b) Authorized government access to contractor data bases; and,

c) Delivery of weapon system technical data in digital form.

It is important to remember while reading this guide that "CALS deliverables" and "CALS requirements" are not entities in themselves, but refer to methods and standards for receiving program data, traditionally delivered on paper, in digital form.

2.0 Acquisition Strategy and CALS

The Acquisition Manager, in developing an acquisition strategy, must consider CALS implementation and its potential for improving acquisition and logistics support processes. The approach to CALS implementation will vary by program acquisition phase and by program type, size and duration. This guide is focussed primarily on CALS implementation for the acquisition of major defense systems and equipment; however, the information provided will prove useful for other acquisitions, including less than major systems (ACAT III/IV), spares reprocurement, product improvements, and Non-Developmental Items/Commercial Off-the-Shelf (NDI/COTS). The Acquisition Manager must assess particular program requirements to arrive at the most effective CALS implementation strategy.

The information requirements of each program are unique and the opportunities for cost-effective application vary among contractors. To maximize the potential benefits to be gained from CALS, the Acquisition Manager must develop a CALS implementation strategy as an integral part of the program acquisition strategy. A complete CALS implementation strategy includes three primary elements:

a) Government Concept of Operations (GCO). The Government concept of digital data usage through each phase of the life cycle, including a summary of Government systems for managing the data. The GCO should be included in the RFP.

b) CALS RFP Requirements. Specific data integration, data access and digital delivery requirements to support the GCO.

c) The Role of CALS in Source Selection. The structure of CALS evaluation criteria and their relative importance.

These three elements are essential to achieve effective implementation of CALS and are discussed in more detail in the following sections of this guide.

3.0 Contracting for CALS

3.1 Government Concept of Operations (GCO)

The objective of the GCO is to provide potential bidders an understanding of general user needs for technical data and user capabilities for handling digital data throughout life-cycle activities. Due to the varying types and levels of data required during the life-cycle phases, it is likely that the GCO will vary by phase.

Specific data formats and delivery or access requirements will be specified in the contract. To provide an overall framework for these requirements, the GCO must address the following factors for each type of contract data (i.e., Program Management data, Engineering data, Logistics Support data, and other technical plans and reports):

1. The specific delivery media desired (hard copy, on-line access or digital delivery) expected for each data type.

2. For categories where on-line access or delivery is expected:

a) The hardware and software systems the Government has or is developing to manage and use the data (the infrastructure).

b) The data users and user locations.

c) How the data will be used (i.e., view only, modify, comment, manipulate, etc...) and the review and/or approval processes to support program functions and activities (e.g., SDR, PDR, CDR, PCA, LSAR reviews, etc.).

d) How the Government will accomplish inspection and acceptance of digitized information submitted by the contractor.

e) How the data is to be interchanged using applicable standards and existing telecommunication capabilities (see MIL-HDBK-59A for detailed description of the use of specifications/standards and communication protocols).

f) Data protection/security requirements including access authorizations and restrictions (classified, sensitive, and proprietary data, etc...).

The Acquisition Manager should work with appropriate Service/Agency CALS focal points (see Appendix A) to identify government capabilities for receiving, accessing and controlling data products delivered by the contractor.

The GCO should be prepared early in program development, concurrent with the preparation of the program acquisition strategy and acquisition plan. The Government must clearly articulate the GCO in the weapon system Request For Proposal (RFP). This will allow each offeror to address the data/information needs, in a cost effective manner, within their individual CALS Implementation Plan (CALSIP) as discussed in paragraph 3.2.1.

3.2 CALS RFP Requirements

The diagram in Figure 1 depicts the contracting methodology for addressing CALS in a program acquisition. During RFP development, the Acquisition Manager should, as a minimum, include CALS requirements for each section of the solicitation as follows:

a) Section B, Supplies of Services and Prices/Costs. A separate Contract Line Item Number (CLIN) should be included for CITIS services. The pricing provided for this line item should not include the cost of developing the data; this is a separate requirement and should be priced separately. The cost of CITIS is defined by the level(s) of service for the length of time proposed by the contractor or specified in the Statement of Work. MIL-F-CITIS (DRAFT), section 80, provides pricing guidance.

b) Section C, Description/Specification/Work Statement. CALS requirements shall be specified that require all program technical information to be created, managed and used in a digital data base environment. The Acquisition Manager should provide reference to the attachment that contains the information strategy/GCO. The Acquisition Manager has the option to specify delivery of a detailed CALS Implementation Plan (CALSIP) as a separate deliverable (reference the Section J CDRL) or as a section of another program, logistics or data management plan (reference the Section C paragraph requiring the other Plan). When CITIS is a firm RFP requirement, section C must detail the specific CITIS capabilities required by the Acquisition Manager. [Sample SOW language to satisfy general CALS requirements can be found throughout MIL-HDBK 59A; MIL-F-CITIS (Draft) provides SOW language and tailoring guidance for CITIS requirements].

c) Section E, Inspection and Acceptance. Generally, current practices apply; however, the Acquisition Manager should consult the Service CALS point of contact for current guidance when preparing this section of the RFP.

d) Section F. Period of Performance. Generally, current practices apply; however, the Acquisition Manager should consult the Service CALS point of contact for current guidance when preparing this section of the RFP.

CONTRACTING MODEL FOR CALS

RFP (DRAFT/FINAL)

B
- CITIS CLIN
- CALS IMPLEMENTATION REQUIREMENTS

C
- CITIS SPEC/REQTS
- GOVERNMENT CONCEPT OF OPERATIONS
- CITIS AND MIL-STD-1840A DATA CONFORMANCE TEST AND ACCEPTANCE
- CITIS PERIOD OF PERFORMANCE

E
- INCENTIVES
- WARRANTY
- TECHNOLOGY REFRESHMENTS

F
- CDRL'S FOR DIGITAL DELIVERY OF DATA

H
- INSTRUCTIONS TO OFFERORS TO SUBMIT A CALSIP
- CALS EVALUATION CRITERIA

J

L

M
-

OFFERER'S PROPOSAL

TECHNICAL
- CALS IMPLEMENTATION PLAN (CALSIP)
  CALS DESCRIPTION
  PROPOSE INTEGRATED ENVIRONMENT FOR CREATION, MANAGEMENT, AND USE OF DIGITAL TECHNICAL INFORMATION

MANAGEMENT
- SUMMARY OF CALSIP

COST
- DIGITAL DELIVERY OF DATA
- CITIS

CONTRACT

B
-- CITIS CLIN
-- RFP SOW FOR CALS/OFFORS CALSIP

C
-- RFP REQUIREMENT
-- RFP REQUIREMENT
-- RFP REQUIREMENT
-- RFP REQUIREMENT

E

F

H

J

FIGURE 1

e) Section H, Special Contract Requirements. To capitalize on opportunities afforded by information technology evolution, a Technology or Performance Refreshment clause should be considered. The Service CALS point of contact should have an example of this clause. In addition, provisions for warranty of CITIS performance, addressed in MIL-F-CITIS (DRAFT), and contractual incentive mechanisms, discussed in Appendix A of MIL-HDBK-59A, section 40.3.4.4-5, should be considered.

f) Section J, Attachments. CDRLs for delivery of digital data and Data Item Descriptions (DIDs) identifying digital data requirements are discussed in MIL-HDBK 59A, Appendix B, section 40.4.3; Appendix D, section 50.2 provides specific guidance on selection of physical media to cite in Block 16 of the CDRL.

g) Section L, Instructions to Offerors (ITO). CITIS, whether a firm RFP requirement or an evaluated option, should be described in a CITIS section of the CALSIP (see paragraph 3.2.1). The Acquisition Manager should require offerors to describe the general procedures, specifications, software applications, and database services used for the generation, storage, and digital exchange of contract-specific technical information between the prime contractor, subcontractors, and the Government. Acquisition Managers should require offerors to address specific improvements that should be attained through application of CITIS. Sample ITO language to propose specific CALS requirements should be obtained from the Service CALS point of contact.

h) Section M, Evaluation Factors. The Acquisition Manager should identify the qualitative and quantitative factors that will serve as the basis for evaluation of CALS (see Section 3.3). The evaluation factors should be consistent with those established in the Source Selection Plan to ensure that numerical and narrative standards and weights can be applied during the evaluation of proposals.

3.2.1 CALS Implementation Plan (CALSIP)

The CALS Implementation Plan (CALSIP) is the "roadmap" for contractor CALS implementation. The CALSIP should be required no later than the Demonstration/Validation phase. This requirement will be stated in section L of the RFP, Instructions to Offerors. The RFP instructions should require the offeror to:

a) identify automated capabilities for developing and integrating data (i.e., creating data once and using to support concurrent engineering and other processes.

b) describe proposed Contractor Integrated Technical Information Services (CITIS; see paragraph 3.2.2.1);

c) propose changes to the delivery media for data types specified in the GCO and CDRL, and provide analysis/justification for the approach(es) selected for delivery of digital data;
d) describe the methodology to be used for tracking actual versus projected cost and benefits for the proposed CALS initiatives; and,

e) outline proposed actions and capabilities to be pursued in subsequent life-cycle phases.

More detailed guidance on the specific content of the CALSIP can be found in MIL-HDBK-59A, section 5.1.2.1.1.

The CALSIP(s) submitted should be evaluated technically using criteria/factors that measure quality and schedule in fulfilling RFP CALS requirements consistent with the information strategy and capabilities identified in the GCO.

In some cases the Acquisition Manager may desire delivery of detailed CALS implementation analyses/studies in support of the program. If so, the Acquisition Manager should cite these requirements separately and should direct the information on these CALS analyses be delivered in accordance with the appropriate CDRL.

3.2.2 Digital Access and Delivery of Information

The spectrum of delivery options of CALS deliverables ranges from paper to magnetic tape and optical disk media to on-line, remote terminal access for exchange of information. In order to reduce the time and resources required to review, validate/verify and approve contractor data, the Acquisition Manager can require replacement of formatted, hard-copy paper deliverables with digital delivery. Digital information delivery would include: 1) on-line access (CITIS), 2) specified formats using digital media (IAW MIL-STD-1840 exchange specification or mutually agreeable software), or 3) a combination of 1 and 2. These requirements must be included in block 16 of the Contract Data Requirements List (CDRL), DD Form 1423, or appropriate contract exhibit for the respective data requirement.

3.2.2.1 Contractor Integrated Technical Information Service (CITIS).

CITIS is a computer-based service that draws upon integrated technical information from throughout a contractor's enterprise to support the product development process. Instead of program and product documentation (typically paper deliverables) being prepared and sent, program and product information may be viewed and manipulated at workstations across a network that includes most Government data users. CITIS provides a single entry point for authorized government access to contractor-maintained weapon system technical data. CITIS should provide remote access data services to the Acquisition Manager and Government technical, business and logistic activities responsible for review and approval of data. CITIS services should also provide access to and management of technical information. CITIS may include communication via electronic mail.

The Acquisition Manager has the option to specify that firm CITIS requirements be addressed and priced in the offerors' proposals; or, the Acquisition Manager may elect to have the offerors submit proposals for CITIS as an alternative to "traditional" delivery of technical information during contract performance. The latter offers the contractors more latitude in defining the most cost-effective approach for digital delivery. Regardless of the approach, the earlier in a program acquisition life cycle the decision to employ CITIS is made, the greater the potential for savings. MIL-F-CITIS (DRAFT), a specification which will establish uniform government functional requirements that can be tailored to defense programs for the acquisition of CITIS, is available from your Service CALS point of contact. (NOTE: MIL-F-CITIS is a draft document currently receiving a coordinated Service/Industry review; however, the specification language and guidance contained in the draft document can be extracted and tailored for use in developing

solicitation documents. Assistance should be obtained from the Service CALS point of contact when using this draft CITIS specification.)

The Acquisition Manager should evaluate contractor proposals for CITIS to support program requirements, beginning with responses received to RFP requirements for the DEM/VAL phase. CITIS can also be evaluated as a streamlining alternative to the acquisition of vast amounts of individual data deliverables. In addition to reducing the number of CDRL's by on-line access to contractor data, benefits from CITIS remote access data services may also include reduction of the number of repositories for data; reduction of cycle times through on-line review, analysis or approval of technical data; and, reduced overall requirements due to availability of information from a single source. Acquisition Managers should review the contractor's plans, policies and procedures for CITIS and plan for substantive and procedural audits, including tests and demonstrations, to ensure conformance to requirements.

3.2.2.2 Digital Media Options

CALS standards should be invoked in block sixteen of the CDRL, or appropriate contract exhibit, for digital delivery of support products (e.g., engineering drawings, technical manuals). The media for transfer (magnetic tape, optical disk, etc.) should be commensurate with Government receiving system requirements. Some digital deliverables, such as technical reports and planning documents, may simply be acquired by specifying acceptable commercially available word processing software in the CDRL and identifying the required (GCO compatible) physical media (most likely a floppy disk).

3.3 Evaluating CALS During Source Selection

During the source selection process, the CALSIP should be evaluated by program office and staff personnel capable of providing a cross-functional review of the submitted proposals. The criteria for evaluation of the proposals should ensure a level playing field is established from which each offeror's CALSIP is evaluated. Acquisition Managers should provide special emphasis and give an increased consideration (scoring weight) to proposals demonstrating life-cycle cost reductions, quality and schedule improvements, and program risk reduction through:

a) Data Automation. It must be emphasized that data must be created digitally at the earliest program phase. Failure to develop data digitally early in a program can lead to costly requirements for data conversion in later phases.

b) Data Integration/Concurrent Engineering (CE). Proposals, as a minimum should demonstrate an understanding of CE, and additional weight should be given to those proposals that contain plans to integrate the generation and use of system design, engineering, logistics and manufacturing data.

c) Digital Access and Delivery of Information.

d) On-line Access to Analysis and Simulation Tools.

The Acquisition Manager may also wish to require a pre-award demonstration of the contractor's CITIS or other CALS-related capability.

4.0 Summary

In support of new and emerging programs, DoD and the Services are gradually developing several functionally common systems as part of an infrastructure modernization effort to manage and use digital technical information. The Acquisition Manager, in planning and contractually implementing an effective CALS strategy, must have current knowledge of these as well as Service specific infrastructure developments. In addition, as lessons are learned on initial CALS implementation efforts, acquisition language and tailoring guidance will be improved. The Service CALS point of contact will be the primary focal point to provide this type of information and identify CALS knowledgeable personnel within each activity that can provide more detailed assistance to the Acquisition Manager.

MIL-HDBK-59A, sections 5.2.1.4-5 provide guidance concerning cost/benefit analysis and incentives relating to implementation of an effective CALS strategy. In general, the Acquisition Manager can expect that CALS implementation, to include the integration of design, production, support and management processes, and the digital exchange of technical information among functional applications, can provide the following types of program benefits:

a) Reduction in paper volume (handling and storage);

b) Faster access and retrieval of more accurate information;

c) More rapid feedback and identification of potential program and technical problems;

d) Improved compatibility of CAD/CAM/CAE systems; and,

e) Greater flexibility in the use of data for analysis of supportability, producibility, simulation/modelling of performance characteristics and evaluation of product improvements.

This integrated product development enterprise will allow for more rapid identification of technical risk; allow rapid trade-offs between design, manufacturing and support; and, improved schedule by eliminating unnecessary deficiency correction activities.

The CALS vision of the future is focused on improved processes enabled by integrated information environments and information networks providing on-line data access. The Acquisition Manager must be aware that CALS is evolving process changes to create, manage and use data that is more accurate, current and readily accessible. As information technology and technical standards for information exchange are improved, the DoD Acquisition Manager will be able to reduce program risks, shorten acquisition cycle time and more effectively manage each new program.

APPENDIX A

CALS POINTS OF CONTACT

Office of the Secretary of Defense
OASD (P&L) CALS
The Pentagon, Room 2B322
Washington, DC 20301-8000
(703) 697-0051
AUTOVON 227-0051

United States Army
DALO-ZB
The Pentagon, Room 3E560
Washington, DC 20301-8000
(703) 614-3711
AUTOVON 224-3711

United States Navy
OPNAV 403
The Pentagon, Room 4B546
Washington, DC 20350
(203) 693-6958
AUTOVON 225-5274

United States Air Force
HQTRS, Air Force Systems Command
ATTN: PLXC
Andrews AFB, DC 20334-5000
(301)981-3915
AUTOVON 858-3915

Defense Logistics Agency
DLA-Z (DRDO)
6301 Little River Turnpike
Beauregard Square, Suite 310
Alexandria, VA 22312
(703)274-4210
AUTOVON 284-4210

DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions on Reverse Side)

1. Document Number: CALS-ACQ-GUIDEA

2. Document Title: DoD Acquisition Guide for Implementation of Computer-aided Acquisition and Logistic Support (CALS)

3a. Name of Submitting Organization:

3b. Address:

4a. Problem Area Paragraph Number:

4b. Recommended Wording:

4c. Reason/Rationale for Recommendation:

5. Remarks:

6a. Name of Submitter:

6b. Work Telephone Number:

6c. Mailing Address:

7. Date of Submission:

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

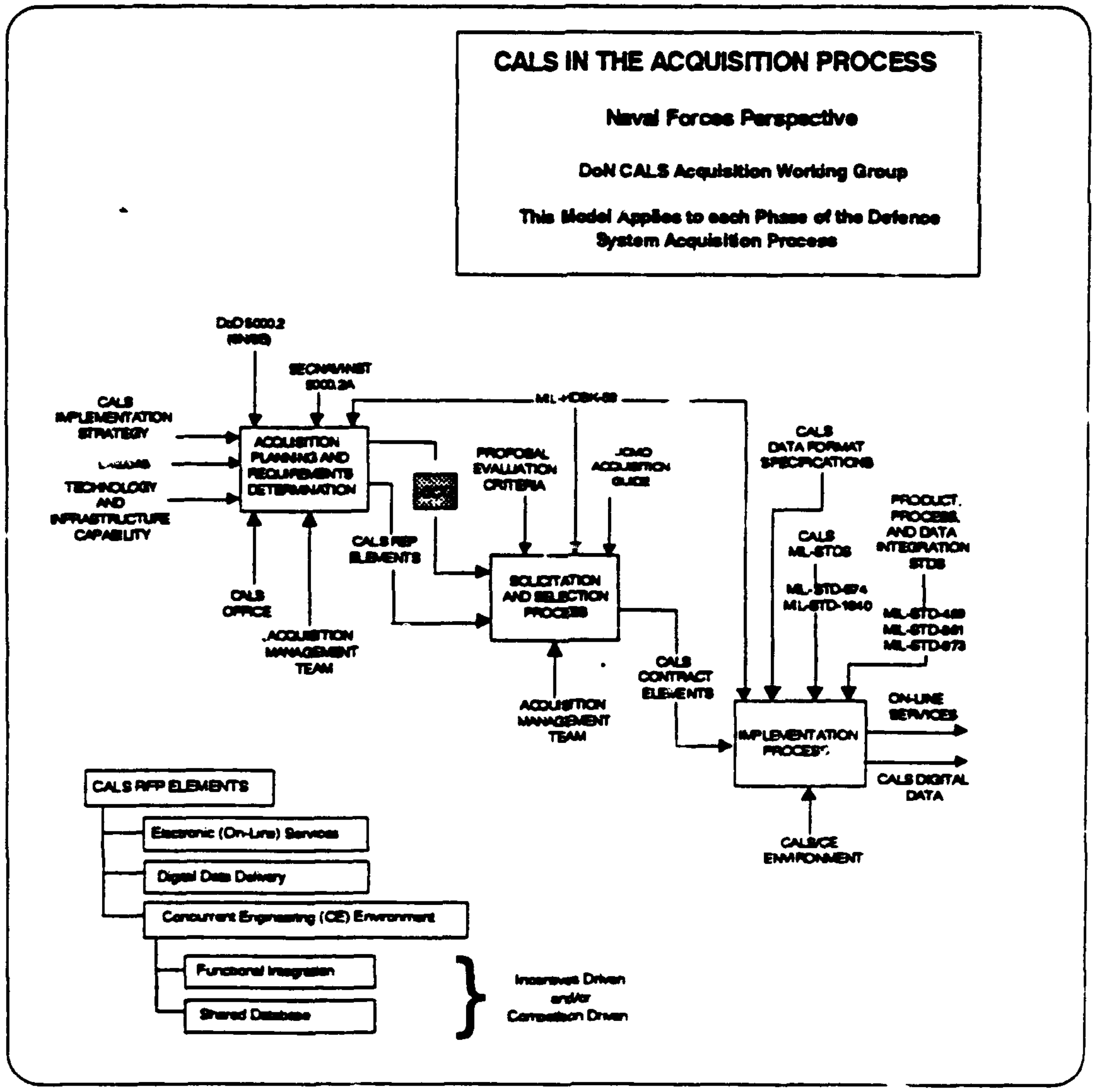
NAVY/MARINE CORPS MANAGER'S DESKTOP GUIDE FOR CALS IMPLEMENTATION

SECOND EDITION
30 JUNE 1993

GUIDE CONTENTS

SECTION 4

Guide For Developing A CALS GCO



GUIDE FOR DEVELOPING A CALS GOVERNMENT CONCEPT OF OPERATION (GCO)

SECOND EDITION

30 June 1993

Prepared by:
CALS Resource and Implementation Cooperative (RIC)

Prepared for:
Navy CALS Acquisition/ Implementation Group

Distribution Statement A. Approved for public release; distribution is unlimited.

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TABLES

1.0 INTRODUCTION

This document provides guidance to acquisition managers and others who have an interest in applying Computer-aided Acquisition and Logistic Support (CALS) to the acquisition of data products in support of defense systems. CALS is a strategy that will enable more effective generation, exchange, management, and use of digital data to support defense systems and equipment including management, design/engineering, manufacturing, logistic support, and operations data. The primary goal of the CALS strategy is to migrate from manual, paper-intensive defense systems operations to integrated, highly-automated acquisition and support processes. The overall intent of the CALS strategy is to improve systems acquisition and product support efficiency and quality. The CALS target is an integrated information environment that will enable continuous process improvement through the use of digital technical information.

The CALS strategy will require different approaches to planning and contracting for the acquisition of defense systems. The information developed by contractors in management, design, build, and support functions for defense systems may migrate to a paperless, digital data delivery and access system. The planning process for implementing various CALS initiatives such as Technical Manual Publish on Demand System (TMPODS), Joint Engineering Data Management Information and Control System (JEDMICS), and Computer-Aided Design (Second Acquisition) (CAD-2) needs to include the development of a strategy for the creation, management, and use of this digital data.

To provide potential bidders with an understanding of specific user needs for technical information throughout all life-cycle activities, a CALS Government Concept of Operation (GCO) should be developed and included in the Request for Proposals (RFP) as Government Furnished Information (GFI). The GCO is developed by the acquisition management team with input from other Government activities involved in the life-cycle support of the defense system.

1.1 Purpose/Scope

The planning process for acquiring any defense system needs to include the development of an information strategy aimed at taking advantage of automation and integration capabilities. This strategy would employ a computer-based environment for generating and storing unique data elements only once and yet provide multiple access to multiple applications. This strategy, depicted in the form of a GCO, identifies typical users' needs for technical data throughout all life-cycle activities of defense systems management, design, manufacture, and support functions.

1.2 How To Use This Document

This document is intended to be used as a guide for creating a GCO. A structural approach to implementing CALS requirements is provided. Figure 1 shows the relationships of the GCO to the contracting process narrated in section 3. Figure 2 diagrams the process required to determine how CALS should be applied to the contract deliverables. Section 4 provides the general requirements and considerations for the process described in figure 2, while section 5 details the specific process for defining the data type, data users, data utilization, user infrastructure, data access/delivery requirements, data format, applicable specifications and standards, and

data delivery media. Section 6 provides considerations for a common thread that should be expressed in all Department of Navy CALS GCOs.

Questionnaire templates contained in exhibit 1 facilitate part of the process in the development of required information for the GCO. These templates should be provided to those Navy/Marine Corps activities that are anticipated to provide support to the specific program for which ~ GCO is being developed. This will aid in identifying the capabilities that exist and their supporting infrastructure. Exhibit 2 contains a sample GCO and a sample Data Item Description (DID) for a CALS Implementation Plan (CALSIP) discussed in section 3.

2.0 REFERENCES

2.1 Acronyms

A complete list of acronyms used throughout the desktop guide is in Appendix A. The acronyms used in this section of the guide are listed below.

ADMAPS	Automated Document Management and Publishing System
AP	Aquisition Plan
ATIS	Advanced Technical Information System
CAC	Contractor's Approach to CALS
CAD2	Computer Aided Design, 2nd Acquisition
CAE/CAD/CAM	Computer Aided Engineering/Computer Aided Design/Computer Aided Manufacturing
CALS	Computer-aided Acquisition and Logistic Support
CALS RIC	CALS Resource & Implementation Cooperative
CALSIP	CALS Implementation Plan
CCITT	International Consultative Committee on Telegraphy and Telephony
CD-ROM	Compact Disk, Read Only Memory
CDI	Compact Disk Interactive
CDRL	Contract Data Requirements List
CGM	Computer Graphics Metafile
CITIS	Contractor Integrated Technical Information Service
CLIN	Contract Line Item Number
CSAR	Configuration Status Accounting Reports
DDN	Defense Data Network
DFARS	Defense Federal Acquisition Regulation Supplement
DID	Data Item Description
DLA	Defense Logistics Agency
DoD	Department of Defense
DoDI	DoD Institute
DON	Department of Navy
DTD	Document Type Definitions
DVI	Digital Video Interactive
ECP	Engineering Change Proposal
EDI	Electronic Data Interchange
EDIF	Electronic Data Interchange Format
EDIFACT	EDI for Administration, Commerce, and Transport
EMD	Engineering and Manufacturing Development
FCIM	Flexible Computer Integrated Manufacturing
FIPS	Federal Information Processing Standard
FOSI	Formatting Output Specification Instances
GCO	Government Concept of Operation
GFI	Government Furnished Information
GOSIP	Government Open Systems Interconnection Profile
IETM	Interactive Electronic Technical Manual
IGES	Initial Graphics Exchange Specification
ILS	Integrated Logistics Support
ILS/LSA	ILS/Logistics
ILSP	Integrated Logistic Support Plan
IWSDB	Integrated Weapons Systems Data Base

JCALS	Joint Computer-aided Acquisition and Logistic Support
JEDMICS	Joint Engineering Drawing Management and
LORA	Level of Repair Analysis
LSA	Logistic Support Analysis
LSAP	Logistic Support Analysis Plan
LSAR	Logistic Support Analysis Record
MACS	Mutually Agreeable Commercial Software
MIS	Management Information System
MPT	Manpower, Personnel, Training
NADC	Naval Air Development Center
NAVAIR	Naval Air Systems Command Headquarters
NAVNET	Navy Network
NAVSEA	Naval Sea Systems Command Headquarters
NAWC	Naval Air Warfare Center
NIMP	Navy Infrastructure Modernization Program
NTP	Naval Training Plan
NWC	Naval Weapons Center
NWS	Naval Weapons Station
OSI	Open Systems Interconnection
PHS&T	Packaging, Handling, Stowage, & Transportation
PMTC	Pacific Missile Test Center
R&M	Reliability and Maintainability
RAMP	Rapid Acquisition of Manufactured Parts
RFD	Request for Deviation
RFP	Request for Proposal
RFW	Request for Waiver
SEMP	System Engineering Management Plan
SGML	Standard Generalized Markup Language
SOW	Statement of Work
SPA	Solicitation Package Automation
SQL	Structured Query Language
T&E	Test and Evaluation
TDP	Technical Data Package
TEMP	Test and Evaluation Master Plan
TM	Technical Manual
TMPODS	Technical Manual Publish on Demand System
VHDL	VHSIC Hardware Description Language
VHSIC	Very High Speed Integrated Circuit
WAN	Wide Area Network
WBS	Work Breakdown Structure
WORM	Write Once & Read Many Times

2.2 Definitions

Definitions of terms used in this section and throughout the desktop guide are in Appendix A: Definitions.

2.3 Applicable Documents

Documents referenced in this section and throughout the desktop guide are listed in Appendix A: Applicable Documents.

3.0 RELATIONSHIP OF THE GCO TO THE CONTRACTING PROCESS

The GCO generated utilizing this guide will provide potential offerors an understanding of specific Government user needs for technical information throughout all relevant life-cycle activities of the defense system. The relationship of the GCO to the various contracting steps is shown in figure 1.

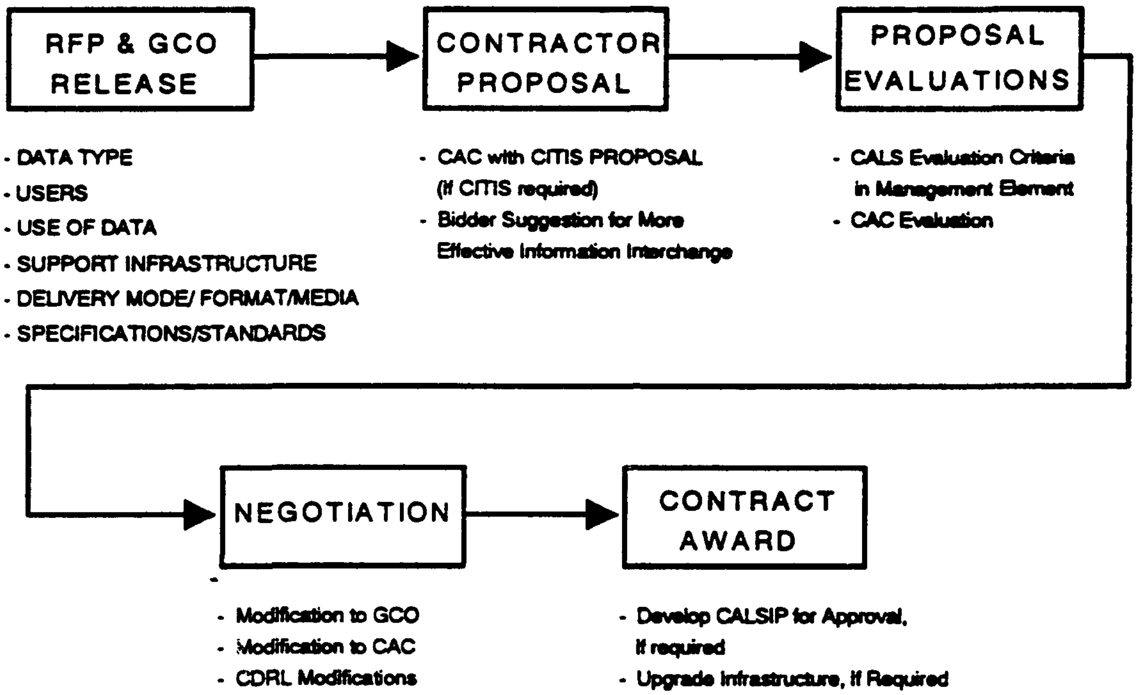

FIGURE 1. The CALS GCO in the Navy/Marine Corps Contracting Process

3.1 RFP and GCO Release

The GCO planning process should start as early in the acquisition process as possible. The GCO is a Government document that is prepared during the acquisition planning and requirements determination activity for each procurement. It is used to provide information to potential offerors about the Government infrastructure and CALS implementation strategy for defense systems. Development of a GCO will help ensure that the Government receives the correct version and formats of digital data products needed to acquire and support a defense system.

The GCO can assist the Acquisition Manager in determining:

- The hardware and software systems the Government has, or is developing, to manage and use the data
- Data users, types of data, frequency of use, and timeliness of data access or delivery to each user
- Data use and the review and/or approval processes to support life cycle functions

- Users' locations and their primary functions in support of the defense system

- Data interchange requirements including format, media, applicable standards, and existing telecommunications capabilities

- Access authorizations and restrictions

- Data acceptance requirements including data format and content of data and the Government processes for accepting product, processable, or Contractor Integrated Technical Information Service (CITIS) data.

A flow diagram of the entire process is shown in figure 2. The suggested methodology to determine the data acquisition requirements as diagrammed in figure 2 is contained in section 4.

3.2 Contractor Proposal

Referencing the GCO, *potential bidders will be required* to develop a Contractor's Approach to CALS (CAC) in their prepared responses to the RFP. The CAC is a description of the contractor's approach, experiences, and successes in the creation, management, use, and exchange of digital information identifying capability in the area of CALS. The CAC can then be evaluated by the Government during the source selection process. If CITIS requirements are included in the RFP, the contractor should address the approach to CITIS within the CAC. See section 4.5 for a more detailed discussion of CITIS.

Bidders should be encouraged to identify, within their CAC, a more efficient and more cost effective data strategy. Section L of the RFP can also be used to offer potential bidders the opportunity to review the GCO and the RFP data requirements and propose alternative forms of delivery of digital data products and information services that reduce life-cycle costs and improve business processes.

3.3 Proposal Evaluation

CALS requirements are typically included in the Management Element of a proposal. Evaluation criteria for CALS in general and the CAC may be derived from MIL-HDBK-59. Information in the CAC is used to gauge the risk associated with the contractor's ability to provide the digital data products and services required by the RFP.

3.4 Negotiation

Differences in concepts of operation between the Government and the bidder selected through the source selection process become the subject for negotiation. The agreements reached during negotiation become the basis for a contract that triggers feedback to all Navy/Marine Corps activities involved in the support of the defense system and subsequent changes to the GCO and perhaps the CAC. Any selected alternatives proposed by the contractor must also be incorporated into the contract and appropriate Contract Data Requirements List (CDRL).

3.5 Contract Award

The solicitation and ensuing contract should state that an objective of the acquisition is to require the contractor to generate information products for all development and production functions in an integrated information system and a shared data environment to the maximum extent practicable. Ideally, this integration should be achieved as part of a comprehensive concurrent engineering strategy. The integrated environment will provide for generation, storage, indexing, distribution, access, and delivery of digital technical data products in support of defense system development and production functions and processes. The objective is to create each data element once and use it repeatedly in subsequent processes without manual reentry.

Developing this integrated environment will most often require a phased approach for implementation. To facilitate a phased implementation of the CALS strategy, the program manager may wish to require a CALSIP as a contract deliverable (typically 60 days after contract award) that is maintained throughout the life of the contract. In such cases, a CALSIP DID, which is in the process of being approved for use, will be required.

4.0 BACKGROUND INFORMATION FOR GCO DEVELOPMENT

The GCO must provide potential bidders an understanding of specific Government user needs for technical information throughout all relevant life-cycle activities of the defense system. The GCO must be thoroughly developed for potential bidders to respond with a proper CAC. Therefore, the acquisition of technical data by the Navy/Marine Corps Program Manager requires a detailed definition of data requirements. The effective definition of these technical data requirements necessitates the complete identification of data needs and uses. Identification of these data requirements can be effectively accomplished through the use of a well-defined process described in 4.1 - 4.8. A flow chart of the entire process is shown in figure 2.

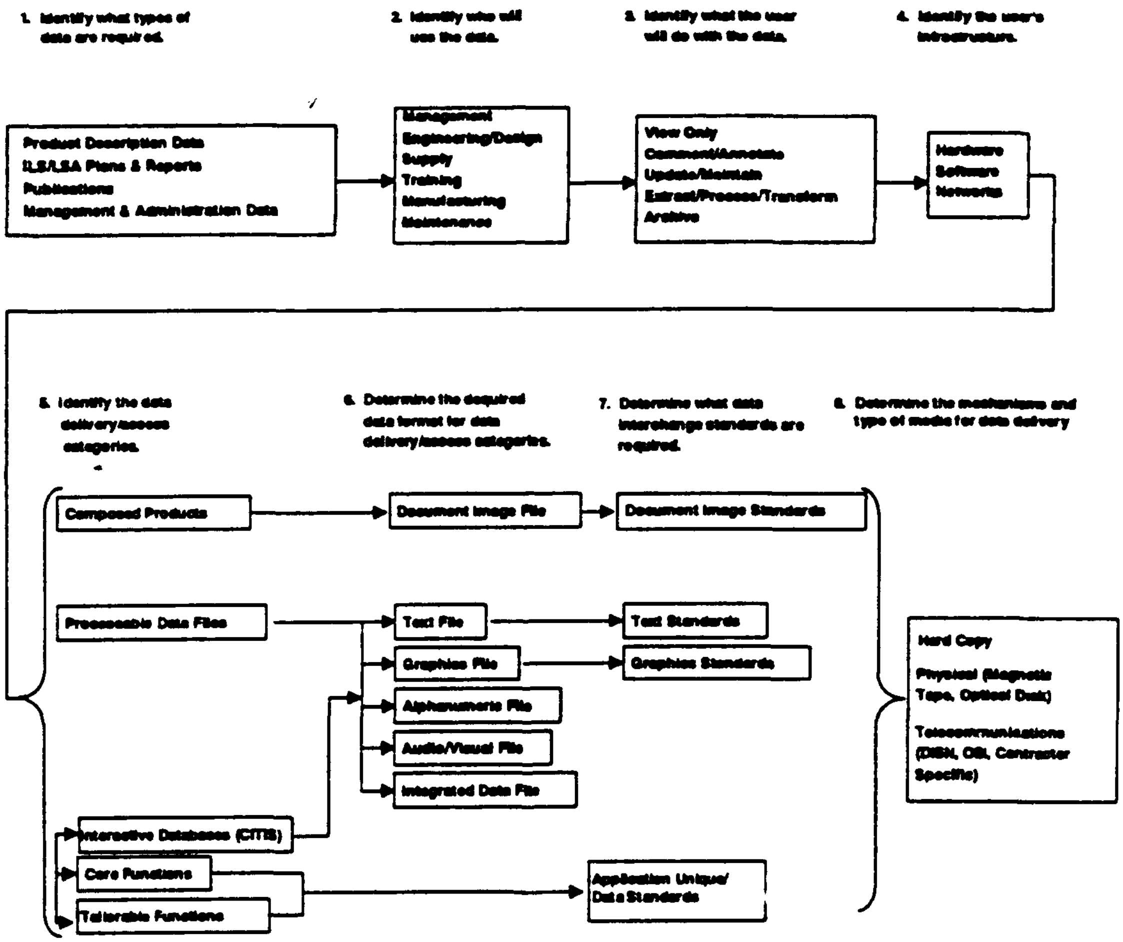

FIGURE 2. GCO Development Process

4.1 Identify Data Type Deliverables

Data type deliverables are the data requirements specified on the Contract Data Requirements List (CDRL) for a typical program categorized by program function. A survey of supporting defense system activities during the Requirements Determination/Data Call process outlined in DoDI 5000.2, part 9, section B, will establish data requirements. Sample data types to be digitally developed, accessed and/or delivered, and maintained are listed in table I. Note that table I. is not intended to be all inclusive.

TABLE 1. Typical Data Type Deliverables

Management and Administration Data:	ILS/LSA Plans and Reports:
• Program Plans	• Integrated Logistics Support Plan (ILSP)
• Program Schedules	• Logistics Support Analysis Plan (LSAP)
• Engineering Support Plans	• Logistics Support Analysis Record (LSAR)
• Progress and Status Reports/Master Schedule	• Safety Assessment Reports
• Contractual Vehicles	• Reliability Assessment Reports
• Conference Agendas/Minutes	• Maintainability Reports
• Reviews and Audits Documents	• Hazardous Materials/Process Reports
• Technical Data Identification Checklists	• LSA Tasks (MIL-STD-1388-1A)
• Standardization Program Plan	• Maintenance Plan/Reliability Plan
• Contract Work Breakdown Structure (WBS)	• Maintainability Plan
• Cost Performance Report	• Level of Repair Analysis (LORA)
• Management Information System (MIS) Plan	• Test and Evaluation Master Plan
• Config. Audit Plan/Status Accounting Report	• Test Reports
• Data accession list	• Life Cycle Cost Estimates
• System Engineering Management Plan (SEMP)	• Configuration Management Plan
• CALS Implementation Plan (CALSIP)	• Manufacturing Plan
	• Environmental Impact Report
Product Description Data:	• Technical Report-Study Services
• Technical Data Package	• Quality Program Plan
• System Specifications	• Computer Resources Integrated Support Document
• Engineering Drawings and Associated Lists	• Design to Cost Plan
• Analysis Data	
• Simulation Data	**Publications:**
• Test Data	• Technical Publications
• ECP, RFW, and RFD	• Technical Manuals
• Product Specification	• User's Manuals
• Software Development Plan	• Operations Manuals
• Software Test Plan/Description/Report	
• System Specification Report	
• System Engineering Analysis Report	
• Engineering Data	

The data type deliverables should be categorized by discipline, functional activity, or other such groupings to facilitate a standardized approach to applying the CALS digital data standards and specifications. Such categorization will also allow the Acquisition Manager to take advantage of common Department of Navy (DON) infrastructure modernization systems and business process improvements. See discussion of a DON standardized GCO in section 6.

4.2 Data Users

The data users, as shown in figure 2, are the functional organizations that will require access to the program data. These organizational areas include: Acquisition, engineering/design, supply, training, manufacturing, and maintenance. In addition to their functional responsibilities, these organizations are defined by their location and the specific disciplines involved. See exhibit 2, table 3-1 for an example.

4.3 Identify Data Use/Processing

The data use requirements are the ways in which the chosen data types may be considered for processing. The Acquisition Manager will need to identify the use of the data types by the support organizations chosen for the program. The five defined methods of data processing typical of most defense systems are described below.

- View Only - the ability to examine a data file without the ability to change it. This includes viewing selected portions of one or several documents as well as side-by-side comparisons of documents.

- Comment/Annotate - the ability to evaluate and highlight for future reference or to make annotations, approvals, and comments without the ability to change the original file. Annotations are associated with a specific item or location within a document such that the annotations are displayed whenever that point or area of the document is displayed.

- Update/Maintain - the ability to change data either directly or through controlling software in the active files on the host computer.

- Extract/Process/Transform - the ability to extract and modify the format, composition, and structure of the data into another usable form.

- Archive - the placing of data into a repository to preserve it for future use.

4.4 Identify Data User Infrastructure

The availability of digital data processing and telecommunications technology and approved standards for creation, storage, transmission, data protection, and integrity of data at the time of delivery or access are important criteria for acquisition decisions. The current and projected capabilities of both the contractor and Department of Defense (DoD) components [military services and Defense Logistics Agency (DLA)] must be assessed with respect to program needs and schedules. The GCO is an excellent vehicle for making these determinations. Acquisition Managers should plan to access or acquire digital data products rather than hard copy unless a clear case can be made that the costs will outweigh the life-cycle benefits.

The data user infrastructure is the computing environment available to a particular user. This environment establishes the data processing capabilities of that user. The following areas identify a user's infrastructure:

- **Hardware**: Determine the current and planned hardware available to support the program.

- Software: This is the most critical element. Interoperability will normally be achieved through the use of software. Again, determine both present and future software applications and availability.

- Networks: Determine the local- and wide-area networking capabilities and whether CITIS will be used.

4.4.1 Navy Infrastructure Modernization Programs (NIMPs)

The Navy/Marine Corps are building various CALS supporting systems for generation, receipt, and processing of digital data. The Acquisition Manager is responsible for determining which of these systems will be used to support the program for digital data. To provide potential bidders with a better understanding of how the data will be used, the NIMPs should be briefly described in the GCO. Contact a Navy/Marine Corps CALS point of contact for more information. Some of the programs are briefly described.

4.4.1.1 Automated Document Management and Publishing System (ADMAPS)

ADMAPS is a contract vehicle that provides a CALS Standard Generalized Markup Language (SGML) publishing system for the acceptance, verification, creation, and updating of TMs and other Navy documentation delivered from contractors or authored within the Navy.

4.4.1.2 Advanced Technical Information System (ATIS)

ATIS is a presentation system designed to place current and accurate digital technical data into users' hands. ATIS allows engineers to access technical documentation, retrieve it from a digital repository such as JEDMICS (see below), and create technical information files containing repair/planning data. Documentation to be available in ATIS includes engineering drawings, TMs, preventive maintenance data, and engineering operating and sequencing data.

4.4.1.3 Computer Aided Design, Second Acquisition (CAD2)

CAD-2 provides the Navy with a suite of necessary off-the-shelf equipment, software, and support services to replace time-consuming manual drafting and obsolete CAD/CAM/CAE capabilities with modern computer assisted technology. This system will be employed to create, manage, and use engineering analysis data, engineering drawings, technical reports, TMs, technical orders, bid packages, manufacturing data, product models, and work packages.

4.4.1.4 Joint Engineering Data Management Information and Control System (JEDMICS)

JEDMICS provides a standard digital system for storage, retrieval, reproduction, and distribution of engineering drawings and related technical data to support defense system maintenance, reprocurement of spares, engineering, training, manufacturing and logistics support.

4.4.1.5 Technical Manual Publish-On-Demand System (TMPODS)

TMPODS provides storage of CALS digital files for output on demand (paper/digital) of Navy/Marine Corps TMs.

4.5 Identify Data Delivery/Access Method

The data delivery/access methods are the ways in which the data types may be accessed or delivered during the life cycle of the program. Digital delivery and access requirements are specified through the Statement of Work (SOW), the CDRL, and specific DIDs. The two options that an Acquisition Manager may use to support digital delivery requirements are physical delivery and on-line delivery via telecommunications. Physical delivery includes delivery of magnetic tape, magnetic disk, or optical disk used to transfer CDRL items to a Government site. On-line delivery may be achieved via two methods: 1) delivery of CDRL items from a contractor sending system to a Government-receiving system via telecommunications download; or 2) in place delivery, which allows data items to be stored and maintained at a contractor site for retrieval and display via telecommunications using a Government terminal, personal computer, or workstation. On-line access, as distinguished from on-line delivery, refers to the situation in which an organization accesses data items through CITIS services or other similar information management services as negotiated in the contract.

Following are types of digital deliverables supported by delivery and access methods specified by Acquisition Managers. Detailed information to assist in developing CDRL specifications for these deliverables is provided in appendix D of MIL-HDBK-59.

- Composed Products: Human interpretable documents in digital image format. These items cannot be further processed since they are complete, published entities. Examples of data products that could be delivered or accessed in this format include legacy engineering drawings, technical reports, and test plans.

- Processable Data Files: Machine readable dynamic information that includes revisable source data for multiple data applications, thus enabling standard and custom documents to be generated and the source data to be manipulated. Examples of processable files are LSAR files and files extracted as subsets of computer-aided design files..

- Interactive Databases: On-line interactive access provides greatest flexibility of data usage with immediate and timely data access for custom report generation, document generation, and on-line request of information transmitted as composed products and processable data files. Acquisition Managers should give preference to use of CITIS for performing the functions of updating, storing, controlling, reproducing, and distributing data items. MIL-STD-974 provides information concerning core CITIS functions and tailorable CITIS functions, which should be specified in the SOW and listed as contract line items.

4.6 Determine Data Format

The following data formats are the forms in which each of the delivery/access methods can be procured. Refer to figure 2 for their relationships to the delivery/access methods.

- Document Image File
- Text File
- Graphics File
- Alphanumeric File
- Audio/Visual File
- Integrated Data File

4.7 Determine Data Interchange Standards

The following types of interchange standards are used with data formats listed in 4.6.

- Document Image Standards
- Text Standards
- Graphics Standards
- Application Unique/Data Standards

4.8 Determine the Media Type

4.8.1 Physical Media

Magnetic tape is a mature, stable technology that is able to handle the large volumes of data typically associated with a major defense system acquisition. Magnetic tape standards are well defined, and little additional investment cost will be involved. However, other media may be more efficient and, therefore, preferred.

Magnetic disk is also widely implemented on personal computers and work stations and may be the physical medium of choice for small business contractors. Several primary de facto magnetic disk formats are available but no official standard has been accepted. Compatibility problems exist, but can be overcome with only moderate effort.

Optical media is used here as a generic term to include Compact Disk, Read Only Memory (CD-ROM), Compact Disk Interactive (CDI) and Digital Video Interactive (DVI), Write Once and Read Many Times (WORM), and erasable optical disk. These media are ideal for mass distribution and archival purposes for large volumes of data.

4.8.2 Telecommunications

Secure, on-line transmission of the full volume of data for defense systems is technically feasible but severely taxes current telecommunication networks in DoD and industry. In the near term, telecommunications may be limited to electronic mail exchange of high-priority technical data or other clearly defined uses such as CITIS access. In the long term, cost effectiveness will be essential for successful implementation of a totally integrated defense system database.

Telecommunication networks provide an excellent opportunity to exchange and establish common practices for business type data using Federal Information Processing Standard (FIPS) PUB 161 for Electronic Data Interchange (EDI) standards. FIPS PUB 161 summarizes the adoption of the families of interrelated software standards known as ASC X12 and Electronic Data Interchange for Administration, Commerce, and Transport (EDIFACT) for electronic transmission of such data. The Acquisition Manager should consider taking advantage of this opportunity for program administration process improvements.

Upon completion of the GCO, the acquisition management team will be prepared to enter the solicitation and source selection process with a firm CALS implementation strategy and knowledge of the needs and capabilities for acquiring and using digital data.

5.0 DATA ACQUISITION REQUIREMENTS METHOD

The identification of information for inclusion in the GCO is described in the following sections and shown in figure 2. The Acquisition Manager can employ and adapt this methodology to a specific acquisition to develop the program requirements for digital data delivery or access.

5.1 Identify Data Type Requirements

The Acquisition Manager will need to select the data types listed in section 3.1 that are necessary to accomplish the program objectives. Each of the specific types of data required will be determined by the unique conditions and constraints associated with a specific program. The data types selected will ultimately influence data format, interchange standards, and media considerations.

The best method for determining the types of data deliverables required is to extract the data deliverables list from the CDRL and to categorize the data types. Table 1 depicts four major categories of data types in terms of technical functions performed for a typical defense system acquisition. Table 2 illustrates that functional areas may be categorized in more detail (training, configuration management) to help in determining which supporting activities require which data deliverables to perform their function(s).

The Acquisition Manager must also be aware of the various NIMPs that are in place, or soon to be in place, to accept, manage and use digital data. Any data deliverables that will require updating and maintenance throughout the life cycle of the defense system (engineering drawings, TMs, LSAR, etc.) are excellent candidates for digital delivery and making use of the NIMP Systems. These systems will allow for a more common approach across DON for developing the GCO. See section 6. The Acquisition Manager should certainly take advantage of these systems in place at supporting Navy/Marine Corps activities for the management and use of data deliverables in digital formats. See 4.4.1.

5.2 Identify Data Users

The Acquisition Manager will need to identify the organization(s) requiring data and the functions of the organization. Program specific conditions and constraints will determine which organizational areas require data. Once the required organizational areas have been determined, the name of the organization, the organization's function (what services they provide), the location of each organization, and the Point of Contact at each organization should be provided. Table 2 is an example of data users for a typical program.

This information provides potential bidders with an understanding of the separation of work functions and the scope of geographic locations for data transmission requirements or other modes of data delivery or access. An added benefit from developing the Data Users Table is provided to the Government in terms of clarifying the functional areas required to support the defense system acquisition.

TABLE 2. Data Users

Organization	Location	Point of Contact	Disciplines (Functional Areas)
NAVAIR	Washington, DC	CDR. J. Wilson, Code 111	Program Management
		S. Sprigg, Code 222	Engineering
		J. Baker, Code 333	Training
		B. Mittle, Code 444	Configuration Management
NWC	China Lake, CA	B. Smith, Code 555	Engineering Support
			Logistics Support
PMTC	Pt. Mugu, CA	R. Griese, Code 777	Logistics Support
		M. Mahafee, Code 839	Training
NADC	Warminster, PA	J. Jones, Code 888	Engineering Support
NAWC	Indianapolis, IN	E. Farm, Code 999	Engineering Support
NWS	Yorktown, VA	D. Bearman, Code 32C	Depot, Maintenance
.	.	.	.
.	.	.	.
.	.	.	.

5.3 Identify Data Use/Processing

The Acquisition Manager will need to consider how the data will be processed to make decisions on digital data requirements and format. The five categories of data use listed in table 3 and described in 4.3 represent typical ways the data types can be displayed and manipulated. This table is provided as a guideline to show how the data may be used but may vary depending on a program's requirements. The data use requirements may be influenced by the data user selected and the supporting infrastructure. For those that need to view the data only, a word processing file will suffice for most data types in lieu of paper. As users' needs become more sophisticated, such as a need to annotate/excerpt or more importantly, update/maintain or process/transform the data, standardized digital delivery becomes even more essential. The Acquisition Manager will need to match the digital data deliverables to the existing or planned suite of equipment that makes up the users' infrastructure.

5.4 Identify Data User Infrastructure

To assist the Acquisition Manager in determining the user's infrastructure and how it will affect the type of data required, a data acquisition questionnaire, exhibit 1, has been developed. Responses to the questionnaire will aid in giving not only potential bidders, but also the Government, a clear picture of the supporting infrastructure in place to support the defense system. The data users' infrastructure or data processing environment will influence several areas of the data acquisition process including delivery/access method, data format, interchange standards for the data, and media for data delivery. Since each supporting activity (data user) may have quite different infrastructures, the Acquisition Manager will need to be aware of the various data requirements imposed by the different infrastructures and make attempts to bring commonality to the suite of tools available.

5.5 Identify Data Delivery/Access Method Required

The Acquisition Manager will need to identify the methods by which data will be delivered or accessed by users. Data use and the user infrastructure will determine the delivery/access method of each data type. If available, interactive access (CITIS) should be the preferred choice of delivery/access. The delivery/access method will influence data format, interchange standards required to produce and exchange the data, and media for data delivery. Table 3 is an example of data delivery/access method as well as other information for a program.

The Acquisition Manager needs to determine whether the data delivery/access method for each data type deliverable falls into the product (documents) classification, processable data files classification, or interactive access (CITIS) classification. See figure 2. Digital data deliverables requiring extensive distribution, frequent comment/update cycles, or those necessary for critical program management decisions are excellent candidates for the CITIS environment. Other deliverables, especially those which would be unwieldy in data file size (some processable data files such as engineering drawings) should probably use more conventional means of delivery (MIL-STD-1840 tape, magnetic disks).

Specific data formats and delivery modes will be stated on individual DD Form 1423 CDRL items. Proper safeguards will be used for classified information (DOD 5520.22M). In general, the following formats and delivery media are recommended for each data type.

- Management and Administrative Data: This data should be available through CITIS. On-line management status data should be analogous to that available to contractor program managers.

- Product Description Data: Initial Graphics Exchange Specification (IGES), MIL-D-28000 format with delivery in accordance with MIL-STD-1840. As digital format and delivery standards are introduced for additional product description data (i.e., intelligent product data, models, etc.), CDRL delivery requirements may be modified appropriately.

- Integrated Logistics Support (ILS) / Logistic Support Analysis (LSA) Plans and Reports: Mutually Agreeable Commercial Software (MACS) formats. Text-based documents should be generated in a commonly-used, word processing format. Ancillary graphics, spreadsheets, and other associated data files should be developed in common business software. These files should be provided as separate files in their native formats (as specified in DD Form 1423s) as well as incorporated into a master document. It is preferred that these files be delivered electronically over the communications network. Depending on file size and communication speed, this may necessitate MACS file compression routines or floppy disk delivery. Relational database formats, as described in FIPS-PUB-127, should be capable of being accessed via Structured Query Language (SQL) and delivered in accordance with MIL-STD-1840. LSAR data tables will be in accordance with MIL-STD-1388-2B.

- Publications: Publications, manuals, specifications, and other documentation that will be updated and maintained over the life cycle of the program should be developed in SGML, MIL-M-28001, with graphics in Computer Graphics Metafile (CGM), MIL-D-28003, and delivered in accordance with MIL-STD-1840.

Table 3. Data Requirements

Data Type	Delivery/Access Method	Format	
MANAGEMENT AND ADMINISTRATION DATA:			
Program Plans	1,2,3	A,B,C,E,F,H,I	a,b
Engineering Support Plans	1,2,3	A,B,C,E,F,H,I	a,b
Progress and Status Reports	1,2,3	A,B,C,E,F,H,I	a,b
Contract Vehicles	1,2,3	A,B,C,E,F,H,I	a,b
PRODUCT DESCRIPTION DATA:			
Drawings/Associated Lists	1,2	B,D,G	a,b
ECP, RFW, RFD	1,2,3	A,B,C,E,F,H,I	a,b
Analysis Data	1,2,3	A,B,C,E,F,H,I	a,b
Simulation Data	1,2,3	A,B,C,E,F,H,I	a,b

1. Composed Products
   A. Hard Copy
   B. Page Image
2. Processable Data Files
   C. Text File
   D. Graphics File
   E. Alphanumeric File
   F. Audio/Visual File
   G. Integrated Data File
3. Interactive Databases (CITIS)
   H. Core Functions
   I. Tailorable Functions

a. Physical (Magnetic Tape or Disk, Optical Disk)
b. Telecommunications (DISN, OSI, Contractor Specific)

5.6 Identify Data Format Required

The Acquisition Manager will need to identify the data format(s) for delivery, which is determined by the delivery/access method described in 5.5. The chosen formats will affect interchange standards used and the media used for data delivery. Table 3 is an example of data format as well as other information for a program.

There is little benefit to receiving hard copy deliverables for any use other than view only. Realizing that most data generated by the contractor now starts out in some digital format (word processing, graphics development, spread sheets, CAD, etc.), the Acquisition Manager should avoid hard copy format whenever possible. As a minimum, document image files (printer description language files) should be considered for distribution in lieu of hard copy.

Most deliverables generated by the contractor can be utilized in their native format (processable data files) if the Government has a compatible suite of hardware/software or a CITIS environment is employed. Also, text, graphics, alphanumeric, audio/visual, and integrated data file formats lend themselves to applying the CALS standards for data interchange. See figure 2. However, it may not be cost effective to apply CALS standards to these data formats until the final deliverable. For example: A TM will go through many iterations of authoring, review/comment, editing, and distribution before the final delivery. Typically, the manual is being developed on a word processor or desk-top publishing system. It may not be cost effective to invoke the MIL-M-28001 CALS standard until such time that the Government has the infrastructure in-place (ADMAPS, TMPODS, see 4.4.1) or takes final delivery of the document and thereby becomes responsible for its configuration control, archiving, and maintenance of the

document. Therefore, the Acquisition Manager may want to take advantage of the native file format during the early phases of the contract if compatible with the existing Government infrastructure.

5.7 Identify Data Interchange Standard

Each of the data formats require certain interchange standards to remain CALS compliant. The Acquisition Manager will need to identify the interchange standard required for each data format. However, these interchange standards will vary depending on the data types selected. User infrastructure will also influence which standards will be invoked. The required interchange standards should be stated in the SOW and the CDRL. Table 3 is an example of data interchange standard as well as other information for a program.

5.8 Identify Deliverable Media

The Acquisition Manager will need to determine the media required for each data type selected. Also, the Acquisition Manager must consider cost when determining media delivery due to the large volume of data required by certain data types. Other factors will influence deliverable media such as, the delivery/access method(s), data format(s), and interchange standard(s) required. The required delivery media should be stated in the SOW and CDRL. Table 3 is an example of data delivery media as well as other information for a program.

Note: The CITIS environment can be considered a media for access and should be listed on the appropriate CDRLs when applicable.

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EXHIBIT 1

Data Acquisition Questionnaire

The following questionnaire will assist in developing a GCO that will be used to tailor a particular data acquisition strategy to a specific program. Depending on the type of acquisition, size of the program, and the phase of acquisition, the content of the program-specific GCO may vary. Each program will require and have access to its own unique infrastructure. This questionnaire is intended to determine the infrastructure in place/required for program-specific support. See 1.2.

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PROGRAM INFRASTRUCTURE QUESTIONNAIRE

The following information is designed to help in determining the hardware, software and networking capabilities/requirements for the ________________ program. This information will aid in determining the data acquisition strategy for this program. It will be used to develop a CALS Government Concept of Operation (GCO) and will be provided in an RFP to potential bidders for developing a CALS Implementation Plan. The types of data, delivery method, access media, mechanics of interchange, and use of the data required for this program will be based upon your responses to this questionnaire. Please fill out this questionnaire as completely as possible and return to the program office no later than ______________.

Questions may be directed to ________________________ at
PHONE:______________
ADDRESS__________________
____
____

I. Data Requirements

Check each data type and its intended use that your organization requires to perform assigned functions in support of this program. Definitions for the different means of using the data are found in MIL-HDBK-59.

Data Type	(V)	(C)	(P)	(U)	(A)
• **Management and Administration Data:**					
• Program Plans					
• Program Schedules					
• Engineering Support Plans					
• Progress and Status Reports/Master Schedule					
• Contractual Vehicles					
• Conference Agendas/Minutes					
• Reviews and Audits Documents					
• Technical Data Identification Checklists					
• Standardization Program Plan					
• Contract Work Breakdown Structure (WBS)					
• Cost Performance Report					
• Management Information System (MIS) Plan					
• Configuration Audit Plan/Status Accounting Report					
• Data Accession List					
• System Engineering Management Plan (SEMP)					
• *					

(V)=View only, (C)=Comment/Annotate, (P)=Excerpt/Process/Transform, (U)=Update/Maintain, (A)= Archive *Fill in others not listed.

Data Type	(V)	(C)	(P)	(U)	(A)
ILS/LSA Plans and Reports:					
• Integrated Logistics Support Plan (ILSP)					
• Logistics Support Analysis Plan (LSAP)					
• Logistics Support Analysis Record (LSAR)					
• Safety Assessment Reports					
• Reliability Assessment Reports					
• Maintainability Reports					
• Hazardous Materials/Process Reports					
• LSA Tasks (MIL-STD-1388-1A)					
• Maintenance Plan/Reliability Plan					
• Maintainability Plan					
• Level of Repair Analysis (LORA)					
• Test and Evaluation Master Plan					
• Test Reports					
• Life Cycle Cost Estimates					
• Configuration Management Plan					
• Manufacturing Plan					
• Environmental Impact Report					
• Technical Report-Study/Services					
• Quality Program Plan					
• Computer Resources Integrated Support Document -					
• Design to Cost Plan					
• *					
• *					
• *					
• **Publications:**					
• Technical Publications					
• Technical Manuals					
• User's Manuals					
• Operations Manuals					
• Maintenance Manuals					
• *					
• *					
• *					

(V)=View only, (C)=Comment/Annotate, (P)=Excerpt/Process/Transform, (U)=Update/Maintain, (A)= Archive *Fill in others not listed.

Data Type	(V)	(C)	(P)	(U)	(A)
Product Description Data:					
• Technical Data Package					
• System Specifications					
• Engineering Drawings and Associated Lists					
• Analysis Data					
• Simulation Data					
• Test Data					
• ECP, RFW, and RFD					
• Product Specification					
• Software Development Plan					
• Software Test Plan/Description/Report					
• Systems Specification Report					
• System Engineering Analysis Report					
• Engineering Data					
*					
*					
*					

(V)=View only, (C)=Comment/Annotate, (P)=Excerpt/Process/Transform, (U)=Update/Maintain, (A)= Archive *Fill in others not listed.

II. Hardware Capabilities

List computer and peripheral equipment that will be used by your organization in support of this program.

	Hardware
Personal Computers	
Mainframes/Minis	

Check the appropriate system block to verify whether or not your organization has access to the following:

- ☐ JCALS System
- ☐ JEDMICS System
- ☐ RAMP Cells
- ☐ FCIM Capability
- ☐ CAD2 Tool

III. Software Capabilities

List operating systems and versions used with hardware described previously. Describe the most common and/or standard commercial software products that have been selected by your organization for each category. Provide version numbers if possible.

	Personal Computer Operating System and Application Software	Mainframe/Mini Operating System and Application Software
Operating Systems		
Word Processing		
Database Management		
Spreadsheets		
CAE/CAD/CAM		
Graphics/ Illustrations		
Other		

IV. Network Capabilities

Describe Local Area Network capabilities that will be used in support of this program.

	Equipment/Product
Network Operating Systems	
Servers(File, Communications, E-Mail, etc.)	
Network Protocols	
External Communication Capabilities (e.g., direct line, DDN, NAVNET, modems, etc.)	

V. CALS Requirements

Check the following boxes to denote your organization's familiarity and use of the following standards/specifications.

☐ IGES (MIL-D-28000)

☐ SGML (MIL-M-28001)

☐ Raster (MIL-R-28002)

☐ EDI (FIPS-PUB-161)

☐ EDIF (ANSI/EIA 548-1988)

☐ IPC-D-350

☐ IETM (MIL-M-87268)

☐ CGM (MIL-D-28003)

☐ VHDL (ANSI/IEEE 1076)

VI. Point of Contact and User Information

List all users requiring access to on-line contractor generated data (CITIS) in support of this program.

Name	Code	Function	Frequency*	Time of Day

*Daily, Weekly, Biweekly, Monthly, Bimonthly, Quarterly, Semiannually, Annually

CALS Point of Contact for your Organization ______________________ Code___

EXHIBIT 2

SAMPLE GCO DEVELOPED WITH AID FROM

THIS GUIDE

This sample GCO is intended for tutorial purposes only and does not necessarily reflect any real or implied infrastructure, program, capabilities, or requirements.

Actual hardware, software, and network vendor names and product names have been removed in table 5-1. In an actual GCO, vendor names and product names including version numbers would be filled in.

1.0 INTRODUCTION

1.1 Purpose

This document is provided as Government Furnished Information (GFI) to address how the Government intends to use data associated with XXX programs in conformance with the Comp:.*er-aided Acquisition and Logistics Support (CALS) strategy. CALS is a strategy that will enable more effective generation, exchange, storage, and use of data for defense systems and equipment, including management, planning, design/engineering, manufacturing, logistic support, and operation data. As such, this document is intended to give participating contractors and other Government activities an understanding of the CALS approach that will be implemented for the XXX program.

1.2 Scope

The policies and strategies set forth in this document are applicable only to the XXX program. The concepts contained in this document apply to all types of data and information that are generated by contractors and by the Government during the life cycle of the XXX program.

1.3 Application

This Government Concept of Operations (GCO) is provided to Government and contractor activities as guidance for their preparation of CALS-related plans and development of CALS capabilities. Government activities should use this document in defining their participation in the XXX program. Contractors should use the GCO in conjunction with a Request for Proposals (RFP) as source information for developing a Contractor's Approach to CALS (CAC). This GCO and resulting CAC provides a basis for further Government and contractor planning for implementation of CALS in the XXX program. Participating activities are encouraged to propose beneficial changes to the information provided herein that improve operation, increase quality, and reduce costs. The GCO is provided for planning purposes and should not be considered as a commitment on the part of the Government.

2.0 REFERENCES

2.1 Specifications

MIL-D-28000 Digital Representation for Communication of Product Data: Initial Graphics Exchange Specification (IGES) Applications Subsets and Application Protocols

MIL-M-28001 Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text SGML

MIL-R-28002 Requirements for Raster Graphics Representation in Binary Format

MIL-D-28003 Digital Representation for Communication of Illustration Data: CGM Application Profile

MIL-T-31000 General Specification for Technical Data Packages

MIL-M-38784 Manuals, Technical: General Style and Format Requirements

2.2 Standards

MIL-STD-100 Engineering Drawing Practices

MIL-STD-974 Contractor Integrated Technical Information Service (CITIS)

MIL-STD-1388-1 Logistic Support Analysis

MIL-STD-1388-2 DoD Requirements for a Logistic Support Analysis Record

MIL-STD-1840 Automated Information for Technical Exchange

MIL-STD-1777 Internet Protocol

MIL-STD-1778 Transmission Control Protocol

2.3 Federal Information Processing Standards

FIPS PUB 127-1 Database Language - Standard Query Language (SQL)

FIPS PUB 146-1 Government Open Systems Interconnection Profile (GOSIP)

FIPS PUB 161 Electronic Data Interchange (EDI)

2.4 Handbooks and Manuals

DOD 5520.22-M Industrial Security Manual for Safeguarding Classified Information

MIL-HDBK-59 DoD CALS Implementation Guide

3.0 DATA REQUIREMENTS

All XXX program data will be considered for generation in digital format. This goal will be achieved through an orderly procession of steps where each deliverable is evaluated as to economic feasibility, intended use, frequency of use, and infrastructure of users. Understandably, certain data deliveries may remain in hard-copy format and may be considered for conversion to digital form when justified by economic and usage factors.

3.1 Data Types

Data types to be digitally developed, delivered, and maintained include, but are not limited to, the following.

- Management and Administrative Data including program plan, program schedules, engineering support plans, system engineering management plan, configuration management data, cost performance report, financial data, notifications, requests, general communications, etc.

- Product Description Data including design, analysis, manufacture, test and inspection information typically included in a technical data package (engineering drawings and associated lists). Product description data also includes data requirements for DoD parts on demand infrastructures, such as RAMP and FCIM initiatives.

- ILS/LSA Plans and Reports including Logistic Support Analysis Record (LSAR) data, LSAP, ILSP, LORA, configuration management plan, reliability and maintainability data, and other data for plans and reports.

- Publications including technical publications, technical manuals, User's manuals, training materials, and operation manuals.

3.2 Data Use

3.2.1 Data Users

Table 3-1 provides an overview of the users that are involved with and require access to XXX program data, their location, and their general data requirements.

TABLE 3-1. Data Users Associated with XXX Programs

ACTIVITY	LOCATION	FUNCTION	DATA REQUIREMENTS
A,F Materiel Command	WP AFB Dayton, OH	Design Agent	Engineering Data Engineering Drawings R&M Data Reports/Plans
		ILS	LSAR Data Tech Pubs Reports/Plans R&M Data Provisioning Data ILS/LSA Data
		Training	Training Planning Data Manpower Rqmts Data Training Materials
Aviation Army Systems Command	St. Louis, MO	ILS Support	LSAR Data Tech Pubs Reports/Plans Design Data
		Training	Training Materials
Aeronautical Systems Center	WP AFB Dayton, OH	Engineering Support (Safety Interface)	R&M Data Reports/Plans Engineering Data Engineering Drawings
		Quality Assurance	ILS/LSA Data Technical Pubs Maintenance Data
		Engineering Support (Avionics & Software)	Engineering Data Reports/Plans
		Engineering Support (Vehicle Dynamics)	Engineering Data Reports/Plans
		MP&T	Hardman Data Training Planning Data Training Material Technical Publications
Army Materiel Command	Alexandria, VA	T&E (Joint Test Coordination)	Engineering Data Engineering Drawings Reports/Plans Test Plans Test Reports Tech Pubs Technical Illustrations
		T&E Training	Training Planning Data Training Materials Manpower Rqmts Data Reports/Plans

TABLE 3-1. Data Users Associated with XXX Programs (con't)

ACTIVITY	LOCATION	FUNCTION	DATA REQUIREMENTS
		Data Analysis	Engineering Data Test Data R&M Data QA/QE Data Operational Data
		Engineering Support (S&V)	Engineering Data Engineering Drawings Reports/Plans
		Technical Data	Tech Pubs Technical Illustrations Engineering Drawings
		In-Process Review	TDP Elements Engineering Dwgs, Assoc. Lists & Related Documents
		Supply Support	Provisioning Data
		Depot Planning	ILS/LSA Data Tech Pubs Maintenance Data
		Logistics Data Analysis	ILS/LSA Data Engineering Data Test Data Operational Data
PMS400 NAVSEA	Washington, DC	Installation/Integration Logistics Data Analysis	Installation Control Dwgs ILS/LSA Data Engineering Dwgs
		MPT	Hardman Data
		Hardman/NTP	Training Planning Data Manpower Rqmts Data
		Training Devices	Engineering Drawings Engineering Data Tech Pubs Training Planning Data Training Materials
		Financial	Cost Data Expenditure Reports
		Facilities	Facilities Data Maintenance Data
		Hazard Analysis	Safety Data
		ILS Support	LSAR Data Tech Pubs Reports/Plans

NOTE: Typical activities are shown in above table.

3.2.2 Use Requirements

The data use requirements are the ways in which the program data will be used and/or processed. The five defined methods of data processing typical of the XXX programs are described below.

- View Only: The ability to examine a data file without the ability to change it. This includes viewing selected portions of one or several documents as well as side-by-side comparisons of documents.

- Comment/Annotate: The ability to evaluate and highlight for future reference or to make annotations, approvals, and comments without the ability to change the original file. Annotations are associated with a specific item or location within a document such that the annotations are displayed whenever that point or area of the document id displayed.

- Extract/Process/Transform: The ability to extract and modify the format, composition, and structure of all or a portion of the data into another usable form without affecting the original content or format.

- Update/Maintain: The ability to change data either directly or through controlling software, in the active files on the host computer. (Contractor-maintained XXX technical data.)

- Archive: The placing of data into a repository to preserve it for future use. (263R task)

Table 3-2 provides a sampling of contract data typical of an XXX program by data type and depicts how the data is intended to be used. This list is not intended to be all inclusive; rather it leads to a decision point for the format and delivery mode of the data deliverables. Data Item Descriptions (DIDs) used are typical DIDs but are not intended to be all inclusive.

Note: Two or more methods may be required by a single user, The methods are not mutually exclusive.

Table 3-2. XYZ Programs contract Data Use Requirements Sample

Data Types	DID	ACQ MGR	COST ANAL	ILS TRAINING	ILS SUPPORT	ILS(HAZ) ANAL		SAFETY	QA	CONTAINER DESIGN/AGENT	DATA ANAL	TECH DATA
MANAGEMENT & ADMINISTRATION DATA												
Conference Agenda	DI-A-77089	C,E,A	C,E,U	C,E	C,E	C,E			V	V	C,E	V
Conference Minutes	DI-A-7089	C,E,A	C,E	C,E	C,E	C,E		V	V	V	C,E	V
Contract Progress Reports	DI-MGMT-807227	A	V	V	V	V			V		V	
Data Accession List	26488-T	E	E		E			E	V		E	
Cost Performance Report	DI-F-6000C	C,E,A	C,E									
Program Plan	DI-MGMT-80909	C,E,A	C,E	C,E	C,E	C,E		C	C,E	C,E	C,E	C,E
ILS/LSA PLANS & REPORTS												
LSA Tasks	DI-ILSS-(Various)	C,E	C,E	V	C,E				V		C,E	
Support Site Activation Plan	DI-FACR-81047	C,E,A	C,E	C,E	C,E	C,E			C,E	C,E	C,E	
Software Test Plan	DI-MCCR-80014A	C,E,A	C,E	C,E	C,E	C,E		C,E			C,E	
Integrated Support Plan	DI-ILSS-80395	C,E,A	C,E	C,E	C,E	C,E		C,E	C	C	C,E	
Engineering and Technical Service Accomplishment Report	DI-MGMT-80061A	E,A	E	E	E	E		C,E	E	E	E	E
System Engineering Management Plan	DI-MGMT-81024	C,E,A	C,E	C,E	C,E	C,E		C,E	C,E	C,E		
Technical Report- Study Services	DI-MISC-80508	E,A	E	E	E	E		C,E	E			

V= View Only
E= Extract/Process Transform
U= Update/Maintain
C= Comment/Annotate
A= Annotate

Table 3-2. XYZ Programs contract Data Use Requirements Sample (Cont.)

Data Types	DID	ACQ MGR	COST ANAL	ILS TRAINING	ILS SUPPORT	ILSA(HAZ) ANAL	SAFETY	QA	CONTAINER DESIGN AGENT	DATA ANAL	TECH DATA
PUBLICATIONS											
System/Segment Design Document	DI-CMAN-80534										
Critical Item Development Specifications	DI-E-3102A	C,E,A	C,E,U	C,E	C,E,U	C,E,U		C,E		C,E,U	
PRODUCT DESCRIPTION DATA	THIS SECTION LISTS ONLY V,C, OR A ENTRIES										
Technical Data Package (Elements)	MIL-T-31000	C	C		C	C	C	C	C		C
Engineering Drawings & Associated Lists						C			C		C
Program Schedule	DI-A-3009	V	V	V	C,E,U	C,E,U	C	C,E	V	V	C,E
Integrated Management Plan	DI-MGT-80004	U	U	U	U	U	C	U	V	V	C,E
Scientific and Technical Rpts	DI-MISC-80711				E			E	E		
Test Plan	DI-NDTI-80566				E	C			E		
Test Reports	DI-NDTI-80604				E	C			E		
Test/Inspection	DI-NDTI-8069A					C	E	C,E	E		
Hazardous Materials	CI-ILSS-81168					C	E		E		
Training Situation Analysis Report	DI-ILSS-81068						E				
Training Equipment Requirements Document	DI-ILSS-81073						E				
Mission Training Task Analysis Report	DI-ILSS-81078						E				
Lesson Plan	DI-ILSS-81095						C,E				
Trainees Guide	DI-ILSS-81100						C,E				

V= View Only
E= Extract/Process Transform
U= Update/Maintain
C= Comment/Annotate
A= Annotate

Table 3-2. XYZ Programs contract Data Use Requirements Sample (Cont.)

Data Types	DID	ACQ MGR	COST ANAL	ILS TRAINING	ILS SUPPORT	ILS/(HAZ) ANAL		SAFETY	QA	CCONTAINER DESIGN AGENT	DATA ANAL	TECH DATA
Logistic Support Analysis Record	DI-ILSS-81173	C,E	C,E,A	C,E	C,E						C,E	
Computer Software Product End Items	DI-MCCR-80700	C	C,E		C,E,U	C,E,U					C,E,U,A	
Support Equipment Installation Data	DI-ILSS-80454	C,E,A	C,E	C,E	C,E	C,E	C		C		C,E	
Failure Summary and Analysis Report	DI-RELI-80255	E,A	E	C,E	E	E		C,E			E	
FMECA Report	DI-R-7085A	E,A	E	C,E	E	E		C,E			E	
Engineering Change Proposal	DI-CMAN-80639	C,E,U, A	C,E,U, A	C,E,U	C,E,U	C,E,U	C,E	C,E	C,E	C,E	C,E	C
Configuration Management Plan	DI-CMAN-80858	C,E,U, A	C,E	C,E	C,E	C,E		C	C,E	C	C	V
Contract Work Breakdown Structure	DI-MGMT-80475	C,E,U, A	C,E	C	C	C		C	C	C	C	
CETS Plan	DI-A-3015	C,E	C,E,U	C,E	C,E	C,E					C	
Cost Schedule Status Report	DI-F-6010A	C,E,A	C,E									
PUBLICATIONS												
Critical Item Product Fabrication Specification	DI-E-3103A	C,E,A	C,E,U	C,E	C,E,U	C,E,U		C,E			C,E,U	
Interface Control Document	DI-E-31031	C,E,A	C,E	C,E	C,E,U	C,E,U		C,E			C,E,U	
Technical Manuals	TMCR-187-91	C,E,A	C,E	C,E	C,E	C,E	C,E	V	V	V		C,E,U

V= View Only
E= Extract/Process Transform
U= Update/Maintain
C= Comment/Annotate
A= Annotate

3.3 Data Delivery/Access Media

Specific data formats and delivery modes shall be stated on individual DD Form 1423 Contract Data Requirements List (CDRL) items. Proper safeguards will be used for classified information (DOD 5520.22M). In general, the following formats and delivery media are recommended for each data type.

- Management and Administrative Data: This data should be available through CITIS. On-line management status data should be analogous to that available to contractor program managers.

- Product Description Data: Initial Graphics Exchange Specification (IGES), MIL-D-28000 format with delivery in accordance with MIL-STD-1840. As digital format and delivery standards are introduced for additional product description data (intelligent product data, models, etc.), CDRL delivery requirements may be modified appropriately.

- ILS/LSA Plans and Reports: Mutually Agreeable Commercial Software (MACS) formats. Text-based documents should be generated in a commonly used word processing format. Ancillary graphics, spreadsheets, and associated data files should be developed in common business software. These files should be provided separately in their native formats (as specified in DD Form 1423s) as well as incorporated into a master document. It is preferred that these files be delivered electronically over the communications network. Depending on file size and.communication speed, this may necessitate MACS file compression routines or floppy disk delivery. Relational database format, as described in Federal Information Publications Standards (FIPS) PUB 127, is capable of being accessed via Structured Query Language (SQL) and delivered in accordance with MIL-STD-1840. LSAR data tables will be in accordance with MIL-STD-1388-2B.

- Publications: Publications, manuals, specifications, and other documentation that will be updated and maintained over the life cycle of the program should be developed in Standard Generalized Markup Language (SGML),MIL-M-28001, with graphics in Computer Graphics Metafile (CGM), MIL-D-28003, and delivered in accordance with MIL-STD-1840.

3.3.1 Preliminary Format and Media Recommendations

Since Plan/Report data types are most common, MACS formats will typically be most frequent. Although electronic deliveries are preferred, these may be limited by the network speed and file size. Therefore, delivery by floppy disk is recommended for MACS deliverables that would overburden the network. As CITIS capabilities and XXX program network performance are increased, more MACS deliveries can be made over the network than by disk. Nine-track tape in accordance with MIL-STD-1840 is recommended for MIL-28000 Series format deliverables. The MIL-SPEC 28000 Series provides implementation-specific guidance for preparation of text and graphic data files for technical publications or product data interchange. These standards are relevant for the preparation of files that are used in MIL-STD-1840 but can also serve many

other data transfer and neutral language format purposes. This set of standards defines how technical data is to be represented digitally in a number of different formats.

With the overall goal of CALS to migrate toward a "digital" environment, MIL-STD-1840 orchestrates the use of the MIL-SPEC-28000 Series and is one of the fundamental standards for digital data interchange of textual and/or illustration/engineering drawing information. Once the acquisition of the data has been resolved, it is MIL-STD-1840 that defines the process for how the technical data is to be transferred.

The MIL-SPEC-28000 Series provides implementation-specific guidance for preparation of text and graphic data files for technical publications or product data interchange. MIL-D-28000 defines the technical requirements necessary to acquire product definition data or product data in a neutral public domain digital format. This specification provides a neutral format (IGES) for the representation and transfer of vector graphics data used for illustration purposes among Computer Aided Design (CAD) systems and application programs used by DoD and industry. MIL-M-28001 defines a standard for preparation of text information for technical publications. MIL-M-28001 SGML is a text mark-up language that is formatted by various Document Type Definitions (DTDs) and Formatting Output Specification Instances (FOSIs) which define format and structure of the text output. MIL-R-28002 defines the technical requirements necessary to acquire raster graphics data and raster graphics applications. Raster data is presently providing a means of converting legacy technical data into a digital format. MIL-D-28003 defines a standard to be met when vector-oriented picture descriptions of illustration data are delivered in the digital format of the CGM.

Specific MACS products have not been finalized but will include popular word processing, spreadsheet, database, project management, and graphics programs. These programs are commonly found in both Government and contractor offices and typically support conversion from one format to another.

3.3.2 Contractor Format and Media Recommendations

The contractor is encouraged to identify and describe alternative formats and delivery media options offering increased utility and cost effectiveness. These formats should be compatible with the infrastructure and data formats described in table 5-1. In determining suitability of a particular format or media option, the contractor should consider the lifetime and purpose of each deliverable.

Relatively short-lived data such as agenda, minutes, planning, schedules, spreadsheets, plans, and progress reports should be developed in MACS products commonly used by all participants of the XXX programs. Involved contractors should review the tools utilized by the Government for such purposes (see section 5). Contractor responses in their CALSIPs will help determine the method utilized to exchange data between the Government and the contractor.

Long-lived data such as engineering drawings, Logistics Support Analyst Record (LSAR), and technical publications are excellent candidates for digital delivery in the CALS standards and specifications formats. These items are archived for long-term storage and protection for future developmental changes and support purposes.

Whenever possible, the government and contractor CALS planning should focus on development of data in a digital format regardless of use. This will assist in ensuring that a future capability for delivery and processing of digital source data is retained.

4.0 CITIS

Implementation of the CALS initiatives for XXX program will require establishment and use of CITIS to provide Government access to contractor-maintained data supporting the XXX program. CITIS should include data management, security, communications, and other attributes necessary to fully integrate the contractor's XXX program databases with the Government user's database. Additionally, CITIS should be capable of storing GFI provided to the contractor. These services should be addressed in the CAC. On the basis of information in the bidder's CAC, the Government will determine the extent that the contractor's proposed CITIS capabilities provide cost-effective use of Government and contractor resources.

4.1 CITIS Capabilities

Contractually required CITIS capabilities will be stated in the contract Statement(s) of Work (SOW). However, contractor participants in the XXX programs should consider establishment of CITIS capabilities that add value to their current efforts. The CITIS services shall include data management, security, telecommunications, and other attributes necessary to fully integrate the contractor's XXX database with the Government user's databases. MIL-STD-974 defines functional requirements for CITIS. There are some capabilities that should be implemented.

- On-line access to contractor-maintained databases containing management, financial, engineering, and logistics program data. On-line access to databases should allow users to perform searches on data, make comments on data, produce and run preformatted (standardized) reports with output at their location, produce ad-hoc reports with output at their location, and download selected data to their location for use in further processing.

- On-line access to contractor-developed or owned applications. This capability should allow authorized users to run contractor-hosted applications from remote computers or terminals. These applications may include modeling, simulations, analysis, and other programs that provide Government users with insight into the contractor's current engineering, logistics, and management efforts.

- File transfer ability. This capability should allow users to download contractor data files (CDRL data files and other information files). This capability should also allow users to upload data files to the contractor (for GFI and information requests).

- Electronic mail capability compatible with the Government E-Mail system(s). This may require communications to a centralized mail server or use of compliant E-Mail packages. GOSIP is the preferred government communications protocol. FIPS PUB 146-1 provides information concerning GOSIP.

4.2 CITIS Data Formats

CITIS data satisfying a CDRL requirement should be formatted to include content specified by the DID. CITIS data required as a result of the SOW should include SOW

specified data in a logical <u>and acceptable</u> format and be easily accessible. The content and format of other CITIS data proposed by the contractor should be in a format consistent with the use requirement.

4.3 Delivery Criteria

Contractor data provided in CITIS as a result of a CDRL will be considered delivered upon acceptance and approval by the requiring office. Other CITIS data is not considered as a "deliverable" but is maintained by the contractor in accordance with update and availability requirements specified by the contract.

4.4 Government Access

CITIS capabilities will be accessible by the Government from existing terminals, personal computers, and workstations. The Government intends to establish permanent communications between the Government's communications network and the contractor sites. The exact implementation of these communications will depend on frequency of access, cost, data volume, and other factors. All communication methods proposed must be compliant with GOSIP.

4.5 Data Protection and Security

CITIS capabilities must include means to ensure only authorized access to and update of information contained within. Data associated with each XXX program will be subject to authentication and regular backup. Periodically, backups will be delivered to XXX program Government service centers.

Methodologies to handle classified data have not been fully determined. It is expected that authorized XXX program users will have access to classified information over CITIS using encryption and decryption devices. Until such time that these devices are determined, classified material should be delivered (in digital and hard-copy format) through conventional means (U.S. Mail).

4.6 Data Rights

Rights in technical and/or business data proposed for or available via CITIS should be negotiated in accordance with DFARS 252-227-7013.

5.0 DESCRIPTION OF GOVERNMENT INFRASTRUCTURE

This section describes the XXX program infrastructure that participating activities and contractors should consider in determining format and communication capabilities. This data is provided to allow program participants to understand the capabilities of other users and to make informed decisions regarding options and capabilities that will be or could be established to support the XXX program(s).

5.1 User Capabilities

Table 5-1 describes a sample of the hardware, software, and communication network capabilities that each user activity would typically have currently. This information **is not intended to be all inclusive**; rather it gives prospective offerors a general insight into the infrastructure in place to support the programs including hardware, software, and networking capabilities of XXX program activities. This information will be updated as user automatic data processing equipment changes.

TABLE 5-1. XXX Program User Capabilities

USER	FUNCTION	HARDWARE	SOFTWARE	NETWORKS
	Program Management, Configuration Management	- Vendor B, Type 1 - Vendor A, Type 1	- Vendor A AP s/w 1, 2, & 3 - Vendor B AP s/w 1,2,3,& 4 - Vendor C AP s/w 1	- Vendor A Type 1 - Vendor B Type 1
	Class Desk	- Vendor A, Type 1	- Vendor A AP s/w 1 - Vendor B AP s/w 1 & 4 - Vendor D AP s/w 1	- Vendor A Type 1 - Vendor B Type 1 - Vendor C Type 1
	ILS	- Vendor B, Type 1	- Vendor A AP s/w 2 & 5 - Vendor B AP s/w 2 - Vendor E AP s/w 1, 2 & 3	- Vendor B Type 1 - Vendor D Type 1
	Training	- Vendor B, Type 1	- Vendor A AP s/w 2, 5, & 6 - Vendor B AP s/w 2 - Vendor C AP s/w 1 - Vendor E AP s/w 1, 2 & 3	- Vendor B Type 1 - Vendor C Type 1 - Vendor E Type 1
	PHS&T	- Vendor B, Type 1	- Vendor A AP s/w 6 - Vendor C AP s/w 1 - Vendor E AP s/w 1 & 2 - Vendor G AP s/w 1	- Vendor C Type 1
	Participating Matrix Codes (Engineering, Cost Analysis, Product Assurance)	- Vendor B, Type 1 - Vendor A, Type 1 - Vendor C Type 1 Type 2 Type 3	- Vendor A AP s/w 1, 2, & 5 - Vendor E AP s/w 1& 2 - Vendor G AP s/w 2 - Vendor H AP s/w 1 - Vendor I AP s/w 1 - Vendor J AP s/w 2 - Vendor K AP s/w 1	- Vendor B Type 1 - Vendor E Type 1

TABLE 5-1. XXX Program User Capabilities (con't)

USER	FUNCTION	HARDWARE	SOFTWARE	NETWORKS
	Program Office, Engineering	- Vendor A, Type 2	- Vendor A AP s/w 1, 2, & 4 - Vendor B AP s/w 1, 4 & 5 - Vendor D AP s/w 1 - Vendor L AP s/w 1 - Vendor M AP s/w 1 & 2	- Vendor A Type 1 - Vendor F Type 1
	ILS	- Vendor B, Type 1 - Vendor D, Type 1	- Vendor A AP s/w 2 - Vendor C AP s/w 1 - Vendor E AP s/w 1 - Vendor G AP s/w 1 & 2 - Vendor N AP s/w 1 - Vendor O AP s/w 1	- Vendor A Type 1 - Vendor B Type 1 - Vendor D Type 1
	Service Center	- Vendor B, Type 1 - Vendor A, Type 1 - Vendor E Type 1 Type 2 - Vendor F Type 1	- Vendor F AP s/w 2 - Vendor T AP s/w 1 - Vendor U AP s/w 1 - Vendor V AP s/w 1 & 2 - Vendor W AP s/w 1 - Vendor X AP s/w 1	- Vendor G Type 1 & 2 - Vendor H Type 1

TABLE 5-1. XXX Program User Capabilities (con't)

USER	FUNCTION	HARDWARE	SOFTWARE	NETWORKS
	Program Office, Engineering	- Vendor A, Type 1 - Vendor B, Type 1	- Vendor A AP s/w 1,3, &6 - Vendor B AP s/w 1 & 4 - Vendor C AP s/w 1 - Vendor E AP s/w 1 - Vendor G AP s/w 1 - Vendor N AP s/w 1 - Vendor P AP s/w 1	- Vendor A, Type 1 - Vendor B, Type 1 - Vendor C, Type 1 - Vendor E, Type 1 - Vendor H, Type 1 - Vendor I, Type 1 - Vendor J, Type 1
	ILS -	- Vendor B, Type 1 - Vendor E, Type 1	- Vendor C AP s/w 1 & 7 Vendor E AP s/w 1 & 2 - Vendor F AP s/w 2 - Vendor G AP s/w 1 - Vendor W AP s/w 1 - Vendor Y AP s/w 1	- Vendor C Type 1
	Service Center (DCC)	- Vendor A, Type 1 - Vendor B, Type 1 - Vendor C, Type 1 - Vendor E Type 1 - Vendor G Type 1	- Vendor F AP s/w 2 - Vendor A AP s/w 1 - Vendor E AP s/w 1 - Vendor G AP s/w 1 - Vendor J AP s/w 1	- Vendor B Type 1 - Vendor I Type 1 - Vendor J Type 1
	Engineering	- Vendor A, Type 1 - Vendor B, Type 1 - Vendor C, Type 1	-Any Commercial Software	- Vendor B Type 1 - Vendor D Type 1
	ILS	- Vendor B, Type 1	- Vendor A, Type 1,2,3 &6 - Vendor B, Type 1	- Vendor B Type 1 - Vendor D Type 1

TABLE 5-1. XXX Program User Capabilities (con't)

USER	FUNCTION	HARDWARE	SOFTWARE	NETWORKS
	T&E	- Vendor B, Type 1 - Vendor D, Type 1	- Vendor A AP s/w 1 - Vendor C AP s/w 1 - Vendor E AP s/w 1 & 2 - Vendor G AP s/w 1 - Vendor L AP s/w 1	- Vendor D Type 1
	Engineering Support (Avionics and Software)	- Vendor B, Type 1 - Vendor C, Type 1 - Vendor E, Type 1 & 2 - Vendor H, Type 1	- Vendor I AP s/w 1 - Vendor J AP s/w 1 - Vendor K AP s/w 1 & 2 - Vendor L AP s/w 1 - Vendor S AP s/w 1	- Vendor B, Type 1 - Vendor C, Type 1 - Vendor G, Type 1
	ILS	- Vendor B, Type 1	- Vendor A AP s/w1,2.4&5 - Vendor E AP s/w 1 & 2 - Vendor G AP s/w 1 - Vendor Z AP s/w 1	
	Technical Publications	- Vendor B, Type 1 & 2 - Vendor E, Type 1	- Vendor V AP s/w 1 - Vendor U AP s/w 1	- Vendor G Type 1 - Vendor J Type 1

TABLE 5-1. XXX Program User Capabilities (con't)

USER	FUNCTION	HARDWARE	SOFTWARE	NETWORKS
	R&M	- Vendor B, Type 1 & 2 - Vendor H, Type 1	- Vendor G AP s/w 1 - Vendor X AP s/w 1	- Vendor I Type 1
	MP&T Analysis			
	Engineering Support (Propulsion)			
	ILS	- Vendor A Type 1 - Vendor B, Type 1 & 2 - Vendor C, Type 1 & 3 - Vendor D, Type 1 & 2 - Vendor E, Type 3	- Vendor A AP s/w 1,2,5&6 - Vendor E AP s/w 1 & 2 - Vendor G AP s/w 1 & 2 - Vendor R AP s/w 1 - Vendor X AP s/w 1	- Vendor A Type 1
	Hazard Analysis			
	Container Engineering			
	Depot Planning	- Vendor B, Type 1	- Vendor A AP s/w 6 - Vendor C AP s/w 1 - Vendor E AP s/w 1	- Vendor B Type 1 - Vendor G Type 1
	Supply Support	- Vendor B, Type 1	- Vendor A AP s/w 6 - Vendor C AP s/w 1 - Vendor E AP s/w 1 & 2 - Vendor G AP s/w 1 - Vendor W AP s/w 1	- Vendor K Type 1 - Vendor L Type 1 - Vendor M Type 1
	Requirements	- Vendor B, Type 1	- Vendor A AP s/w 6 - Vendor C AP s/w 1 - Vendor E AP s/w 1 & 2 - Vendor G AP s/w 1	- Vendor B Type 1
	Supply Support			

TABLE 5-1. XXX Program User Capabilities (con't)

USER	FUNCTION	HARDWARE	SOFTWARE	NETWORKS
	PHS&T	- Vendor B Type 1 - Vendor D Type 3 & 4	- Vendor A AP s/w 5 & 6 - Vendor C, AP s/w 1 & 2 - Vendor E AP s/w 2 - Vendor G AP s/w 1 & 2 - Vendor M AP s/w 1 - Vendor R AP s/w 1	- Vendor B Type 1 - Vendor I Type 1
	Engineering Support (Vehicle Dynamics)	- Vendor A Type 2 - Vendor B, Type 1 - Vendor C, Type 3	- Vendor A AP s/w 2, 3 &7 - Vendor B AP s/w 2,4 &5 - Vendor E AP s/w 1 & 2 - Vendor R AP s/w 1 - Vendor X AP s/w 1	- Vendor B Type 1 - Vendor D Type 1
	Technical Data	- Vendor I, Type 1		
	In-Progress Reviews			
	Logistics Data Analysis			
	Facilities			
	Logistics (Spares Budgeting)			

5.2 Infrastructure Modernization Programs (IMP)

The DoD is building various CALS-supporting systems for generation, receipt, storage, distribution, and processing of digital data. These systems, briefly described below, will be used to various extents in XXX programs depending on the programs' data requirements, existing capability, and IMP availability. Additional detail regarding exact systems to be used and their capabilities will be provided as they become available.

- Digital Document Management and Publishing Systems allow for the acceptance, validation, maintenance, and publishing of SGML-encoded technical manual data. These systems will provide for the continued use and maintenance of digitized technical documentation throughout the life cycle of a defense system.

- Digital Technical Information Systems are typically capably designed to place current and accurate digital technical data into users' hands and allow engineers to access technical documentation, retrieve it from a digital repository, and create technical information files containing repair/planning data. Documentation to be available includes engineering drawing, technical manuals, preventive maintenance data, and engineering operating and sequencing data.

- Joint Engineering Data Management Information and Control Systems (JEDMICS) provide a standard digital system for storage, retrieval, reproduction, and distribution of engineering drawings and related technical data to support weapon system maintenance, reprocurement of spares, engineering, training, manufacturing, and logistics support.

- Solicitation Package Automation (SPA) stores CALS-compliant digital solicitation packages (forms, clauses, technical specifications, and drawings) for print-on-demand output at the two inventory control points.

- Interactive Electronic Technical Manual (IETM) is a computer-based collection of information that can be used for the diagnosis and maintenance of a defense system, optically arranged and formatted for interactive presentation to an end user on an electronic display system. IETM is an interactive display system using optimally packaged and formatted technical information for screen presentation of maintenance and diagnostics information.

- Joint CALS (JCALS) is a DoD initiative to address a global, integrated database serving all database system users; connectively of all users by local and wide area networking; implementation and incorporation of existing and evolving digital data standards; provision of a trusted computing environment implementing B1 level security; and an open systems environment to provide flexibility and to protect against premature obsolescence. The primary goal of the current JCALS design is the integration of databases into a shared structure, an Integrated Weapons Systems Data Base (IWSDB), while creating an environment where logistic technical information could be processed efficiently.

6.0 XXX PROGRAM CALS IMPLEMENTATION

For the XXX programs, the Government plans on establishing a distributed information network system. Figure 6.1 depicts a representative functional arrangement of the XXX program network that will be implemented during engineering and manufacturing development and used throughout the life cycle of the XXX program.

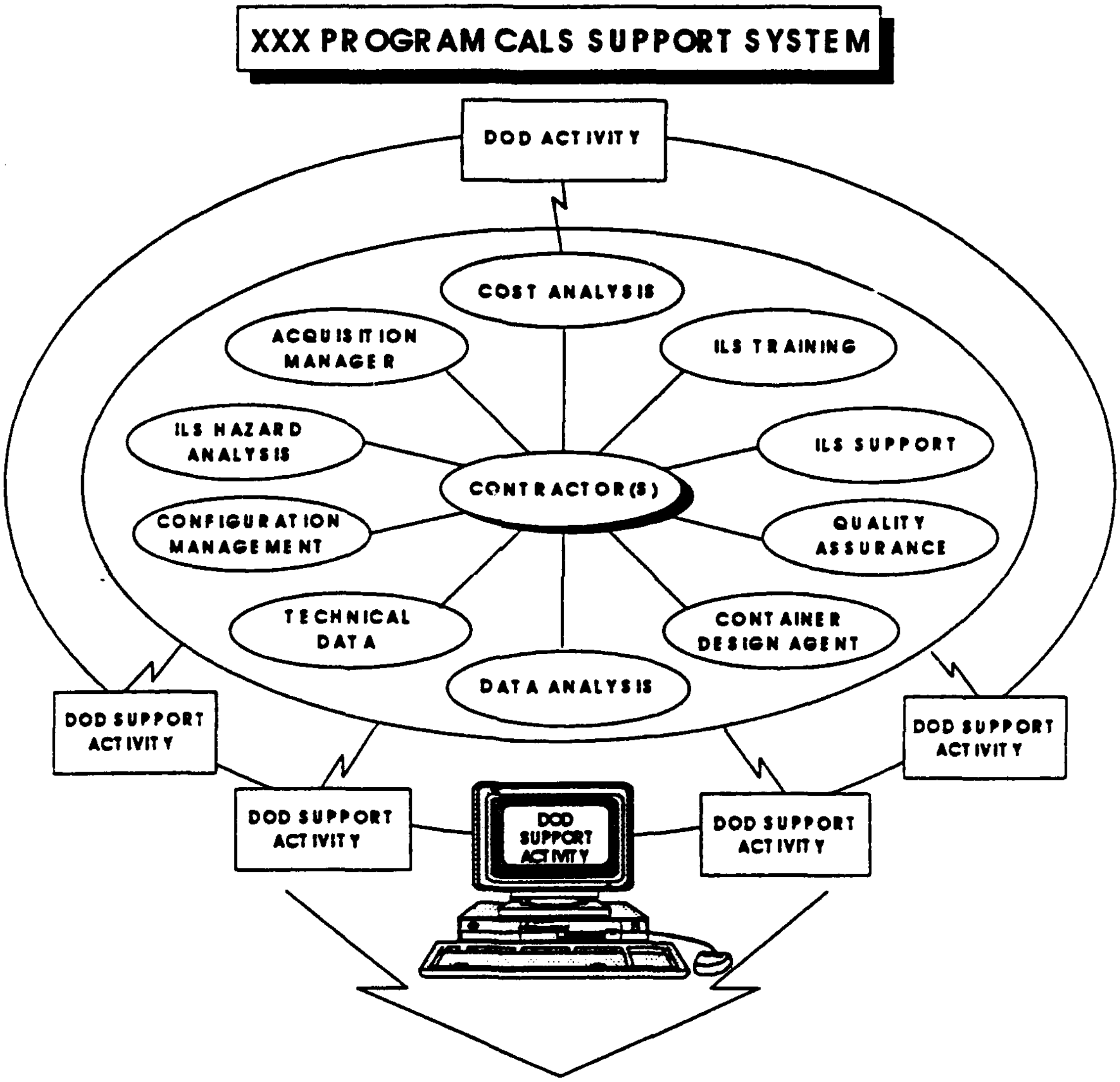

FIGURE 6.1. CALS Functional Arrangement

As is illustrated, this network ties all XXX program activities together by a Wide Area Network (WAN). This WAN will be implemented under a Computer and Telecommunications Command Network. Authorized users will have access directly or through dial-up modems as dictated by data volume, current and planned telecommunications, and program requirements. The function of the XXX program WAN is to provide electronic communications among all XXX program activities, thereby allowing electronic:

- Communications among all activities via electronic mail (E-Mail)
- Transfer of deliverable data files from the contractor to the XXX CALS service center or directly to users as specified on DD Form 1423s
- Transfer of contractor-deliverable data files from the service center to users
- Transfer of program data files among Navy users
- Transfer of GFI directly to contractors
- Access to CITIS by all authorized users.

Contract delivery of magnetic or on-line transfer data will be to the XXX program service center. The service center will perform data management and perform as the repository for all XXX program contract deliverables. Specific functions to be performed are to be determined.

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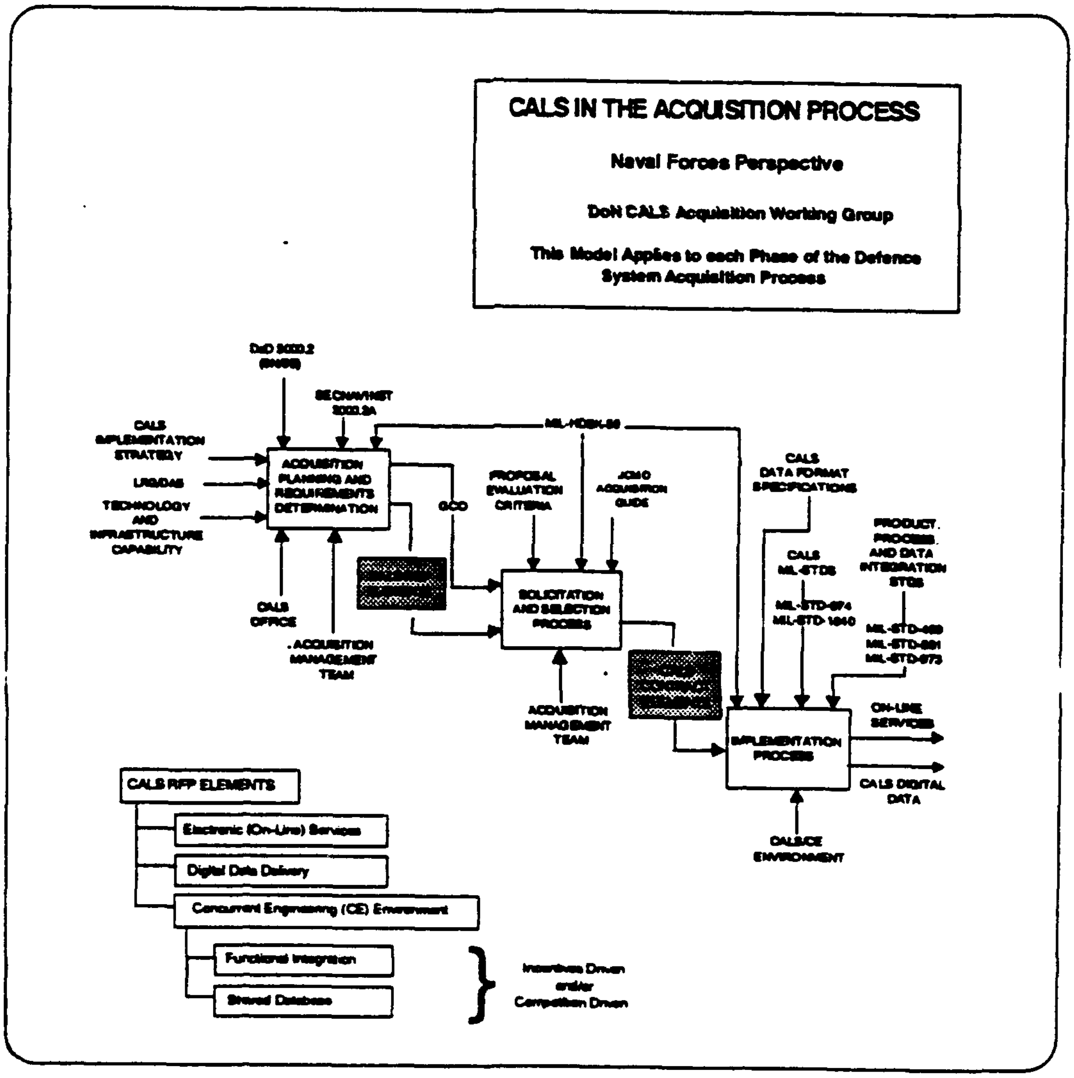
COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

SECTION 5

SAMPLE Statement Of Work Language



SAMPLE STATEMENT OF WORK LANGUAGE

General

This Generic Statement of Work (SOW) provides sample language to assist in the implementation of Computer-Aided Acquisition and Logistics Support (CALS) for an acquisition program. The content within each sample paragraph should be tailored for each application. This CALS-related language should be used in developing the functional requirements within each applicable section of the Request For Proposal (RFP) SOW. This language is not intended to be inserted as a stand-alone section within the RFP SOW.

SOW Para. 1.0 Scope

The contractor shall establish a digital technical information (TI) system to provide automation and integration of the generation, delivery, and uses of [program name] technical information over the ["defense system" or "equipment"] life cycle. Unless otherwise specified within the contract, all, or any portion of, the technical information (TI) specified herein shall be developed in a digital form compatible with requirements stated herein. Unless specifically stated herein, the following requirements do not replace or amend requirements for delivery of TI in non-digital forms specified in elsewhere in the contract.

SOW Para. 2.0 Specific Requirements

The contractor shall implement a CALS program that will achieve the following objectives:

a. Integrate contractor technical information systems and processes;
b. Authorize Government access to the contractor data base(s); and;
c. Deliver technical information in digital forms using the MIL-STD-1840 and accompanying specifications for data interchange (MIL-28000 series).

SOW Para. 2.1 CALS Implementation Plan (CALSIP) [OPTIONAL for Section C SOW; preferred use is Section L for delivery as a proposal requirement for evaluation during source selection. If deemed necessary as a CDRL delivery requirement, recommend include in a section of an existing Management Plan (Program, System Engineering or ILS) deliverable rather than as a separate document.]

The contractor shall develop and maintain a current, comprehensive and detailed CALS Implementation Plan (CALSIP) outlining the procedures to be used to accomplish the CALS requirements defined in [Section X.X] of this statement of work (SOW). The CALSIP shall address capabilities for automating the access and retrieval of CAE/CAD/CIM/logistics technical data, and provide for digital exchange and integration between the engineering, manufacturing, logistics and other functional areas as appropriate to this acquisition phase of the program.

The CALSIP shall address, as a minimum, the following:

a. CALS objectives, strategy and management approach, including application of Concurrent Engineering
b. Database architecture, covering operational requirements and system tradeoffs
c. Digital data validation and verification and conformance to standards for delivery
d. Telecommunications, data rights/access and system/physical security

SOW Para. 2.1.1 CALS Approach

The contractor shall define a specific CALS implementation objective and strategy, taking into consideration technical constraints, quality and cost guidelines and the Government Concept of Operations (GCO) established by the service Acquisition Manager. This strategy shall be supported by necessary trade studies, and shall describe the framework for CALS implementation activities to be accomplished during each phase of [program name] system development. The strategy shall define how the principles of concurrent engineering will be applied, identify the critical enablers for CE (i.e., integrated data base), and provide details on how program risk and costs will be reduced and product quality improved through CE initiatives. The implementation strategy shall serve as a guide in developing contractual requirements for later program acquisition phases. [The following additional language should be used in Section C SOW if CDRL deliverable is desired.] The CALSIP will be updated [days] prior to the end of this contract phase and shall define implementation plans for the upcoming phase in greater detail, resolve outstanding strategy issues, respond to strategic and technology changes, and recommend specific alternative approaches for continuation of CALS in the next phase.

SOW Para. 2.1.2 Database Architecture/System Tradeoffs

The contractor plan shall propose ["provide" if Section C SOW and CALSIP is CDRL deliverable] a cost effective method of managing the utilization of the contractor set of automated data processing systems and applications which support specific weapon system technical data base(s) such that appropriate configuration and version control of technical information is maintained, while providing current data for design, engineering analysis, manufacturing, and product support planning. [The following additional language should be used in Section C SOW if CDRL deliverable is desired.] The contractor shall conduct appropriate tradeoffs studies/ analyses to support determination of the CALS implementation strategy. The status of these studies shall be reviewed at appropriate program management, design, and ILS reviews, and the results documented as part of the CALSIP. Candidates for such studies include:

[Examples only; final determination is program specific]

- improved alternate data generation and delivery modes
- digital data delivery vs. on-line access
- identification and elimination of unnecessary CDRL items
- identification of CDRL items for interactive, on-line review
- analysis of telecommunication alternatives
- functional integration cost/benefit studies
- cost effectiveness of contractor interim CALS support [particularly in areas where infrastructure or capability limitations can be overcome through use of hardware/software leased from the contractor].

SOW Para. 2.1.3 CALS Standards Conformance Test

The contractor shall include in the CALSIP plans to demonstrate the exchange of digital deliverables using the CALS standard formats, in accordance with the full requirements of MIL-STD-1840 and all tiers of references (specifically MIL-28000 series format/interchange specifications). This shall be accomplished through testing provided by the Government or an industrial organization(s) chartered to perform such conformance test. [The following additional

language should be used in Section C SOW if CDRL deliverable is desired.] Additionally, TI deliverables must pass a first article test on all formats to ensure conformance to the CALS specifications.

SOW Para. 2.1.4 Security [Section C SOW requirement only]

The contractor shall establish a security system and enforce data protection and integrity standards. System security engineering principles as outlined in MIL-STD-1785 shall be used. Controls to prevent unauthorized access shall be established and detailed in the CALSIP. The plan shall be based on the results of documented data protection and integrity, threat and vulnerability analysis, risk assessments, and tradeoff analyses. Vulnerabilities that remain after security system design shall be identified. The plan shall include disaster recovery provisions. Security requirements that must be complied with by Government personnel will be identified to the Government in the security section of the CALSIP. Any peculiar software that must be resident on Government access terminals will be provided and maintained by the contractor. Information requiring special security provisions such as classified data, critical technology and proprietary, competition or liability sensitive data will be partitioned to minimize the volume of information requiring specialized handling, to provide classification at the lowest classification level, and to control access. Encryption of classified data or sensitive military data shall be stipulated by the CDRL and on an as-required basis in accordance with procedures established by the National Security Agency. Such information shall be identified to prevent inadvertent disclosure and retention of security identification for printouts of accessed information. The contractor shall pay particular attention to unclassified items of information, which, taken together, can infer classified information. The contractor shall maintain configuration control of the security system and trusted system components. The contractor shall conduct a test and evaluation of the system and periodic inspections to ensure compliance. The Government shall retain the right to conduct announced and unannounced inspections by security specialists at any time to review, audit, and account for classified materials.

SOW Para. 2.2 Program Assessment and Control - DoD Reviews

The CALSIP shall describe the procedures and controls by which the contractor and the Government will evaluate the status and effectiveness of CALS. The implementation of the CALS will be a subject of review at program, design and ILS reviews.

SOW Para. 2.3 Post Award CALS Program Orientation Conference [Section C SOW language only]

The prime contractor shall host a post award CALS program orientation conference to be scheduled no later than [number] of days after contract award. A representative from the [program name] program office shall chair this conference. Major prime contractor teaming partners/subcontractors shall attend. The agenda for this conference shall be approved by the [program name] program office. The purpose of this CALS meeting is to clarify the GCO and have the contractor present to the Government their plans for on-line access if required, exchange and delivery of digital data.

SOW Para. 2.4 Government Furnished Information (GFI)

The contractor CALSIP shall describe the GFI the contractor expects to receive from the Government. The list of GFI the Government plans to provide is included in attachment/exhibit

[number]. This list should include those elements to be addressed in the GCO. The GCO will define infrastructure capabilities to receive and use various types of digital data and technical information. The contractor shall use this GFI with contractor generated data.

SOW Para. 3.0 Contractor Integrated Technical Information Services (CITIS)

The contractor shall propose ["develop" if Section C SOW requirement] a program composed of procedures, processes, specifications and software applications for the integration, storage, exchange, and/or on-line sharing of data with the Government. These technical data and data base(s) and functional application capabilities provided within the contractor's system shall be referred to as the CITIS. This CITIS shall be developed using the CITIS Functional Specification, Attachment ( ), and the following.

The contractor shall propose ["develop" for Section C SOW requirement] a technical information (TI) and program management architecture, with a functional and hierarchical indexing system to:

- Manage configuration of the entire TI and planning data bases,
- Integrate planning information into its respective TI source data base; and
- Trace configuration changes from design to logistics products and vice versa.

The contractor shall propose how he will ["is required to" for Section C SOW language] establish a link among logistics, design, engineering, and manufacturing data and functional processes to facilitate the interchange and exchange of technical information; integrate technical data and data base(s) to support the design, manufacturing and support processes and allow for timely access by authorized Government activities; provide an integrated, shared data environment, consisting of integrated data bases, analysis tools, and engineering processes designed to utilize digital TI; and, provide for the generation, storage, indexing, distribution, and delivery of integrated acquisition and logistics information products. In the selection of analytical tools, the contractor shall maximize the use of previously developed or off-the-shelf software. These software tools shall be compatible with hardware/software system specified in the GCO, unless contractor developed, unique software solutions are demonstrated to be more cost effective.

The contractor's telecommunications solution for CITIS shall comply with Government Open System Interconnect Protocols (GOSIP). The U.S. GOSIP specified protocols are required as contained in FIPS 146. GOSIP includes selected Open Systems Interconnection (OSI), Institute of Electrical and Electronics Engineers (IEEE) and International Consultative Committee for Telephone and Telegraph (CCITT) specified protocols.

SOW Para. 3.1 Data Element Dictionary [Section C SOW only]

A general data element dictionary shall be developed so that identical data elements are addressable by the computer as the same data element. Changes to any duplicate data element shall be effected throughout all data bases. A similar methodology shall be developed for graphics and large textual entities to ensure that changes to the source graphic correctly flags the necessity for change to all dependent graphic/textual entities derived from the source graphic. The contractor shall use existing MIL-STD data dictionaries, to include MIL-STD-1388-2, and use MIL-HDBK-59 as guidance in constructing the (program) data dictionary.

SOW Para. 4.0 Engineering Data (graphic and text files) [Section C SOW only]

Any data, either Government, contractor, or vendor, that contains engineering definition or guidance on material items (components), equipment system practices, methods, and/or processes relating to the design, manufacture, acquisition, test, inspection shall be submitted in digital form in accordance with MIL-STD-1840A and compatible with the data repository/receiving systems specified in the GCO.

[The following paragraphs contain language that should be integrated with the specific functional area that it addresses.]

SOW Para. 5.0 Automation & Functional Integration

The contractor should use computer-aided design, engineering, and manufacturing methods (CAD/CAE/CAM) to support design integration with manufacturing planning and logistic support system development. These software tools shall be compatible with hardware/software systems specified in the GCO, unless contractor developed, unique software solutions with are demonstrated to be more cost effective. An integrated set of ADP systems and applications will be used by the contractor team to enter, update, manage, and retrieve data from specific (program) technical data base(s).

SOW Para. 5.1 R&M Automation

The contractor shall employ automated tools for performing R&M tasks. The contractor shall integrate these R&M tools with other CAE tools. These tools may stand alone with no direct access to the CAE data base; reside in the CAE system and interfaced with the evolving design; or, reside on the CAE system and be automatically invoked to support design decisions. The R&M methods and tools used by the contractor shall, as a minimum, include:

- Automated R&M analysis procedures coupled to parts libraries and to material characteristics data bases.
- Automated R&M synthesis based on design rules and lessons learned from prior design experience and field use.
- Fully characterized (tested and validated) component performance and R&M characteristics data bases.
- Design decision traceability.

SOW Para. 5.2 R&M-LSAR Integration

The contractor shall establish an automated link to satisfy LSAR documentation requirements for initial and updated reliability and maintainability (R&M) information. Algorithms or transformations that must be applied to R&M source data elements to conform to LSAR documentation requirements shall be documented. Traceability between the LSAR and individual R&M data sources, and the preservation of appropriate data flows while maintaining established LSAR data element relationships and interdependencies, shall be clearly demonstrated.

SOW Para. 5.3 LSAR Data Automation

The contractor shall establish and maintain a validated LSAR automated data processing system capable of input, storage, and retrieval of LSAR data in accordance with MIL-STD-1388-2. The

contractor may use an internally developed and Government validated LSAR automated data processing system, or independently developed and Government validated LSAR automated data processing system. The contractor shall partition LSAR working data for in-process reviews and maintain these files separate from Government approved LSAR data. The LSAR version containing the submitted data shall be the LSAR that has been subjected to internal contractor review procedures and is pending Government review and approval. The LSAR working data shall be updated in accordance with the schedule in the LSA plan regardless of the approval status of the working data's content since the last update. Upon Government approval, LSAR working data shall be transferred to the Government approved LSAR. All Government directed changes resulting from the LSAR data shall be cumulative of all Government approved LSAR data. Delivery of LSAR data shall be IAW the CDRL.

SOW Para. 5.4 Reliability Centered Maintenance (RCM) and Age Exploration Automation

The contractor shall develop an automated system to maintain a complete RCM audit trail throughout the [program name] life cycle. This audit trail will permit traceability of preventive maintenance tasks back to specific engineering failure modes listed in the LSAR. The automated RCM analysis process must have the capability of delivering results digitally and through an interactive electronic interface with the LSAR data base. The contractor shall utilize the RCM automated worksheet process or a contractor developed, DoD validated, RCM automated process with the capability of automatically transferring compatible data to the Government RCM software. The automated RCM analysis data/work-sheets must be delivered to the Government in accordance with the CDRL.

The contractor will develop an Age Exploration (AE) data base for the storage and analysis of in-service/operational age-reliability data which shall be used to support the RCM analysis process. The AE data base shall be integrated digitally and have an interactive electronic interface with the RCM automated process.

SOW Para. 5.5 Level of Repair Analysis (LORA)

The contractor shall employ an automated system to perform LORA in accordance with the requirements specified MIL-STD-1390. The contractor shall establish a data base as a repository for LORA input data and LORA output report files generated by execution of the LORA model software. The LORA data base will be integrated with the automated LSAR data base to maintain traceability of LSA data used as input to the LORA. The output results of the LORA shall be documented in the LSAR for development of the LSA-024 maintenance plan report. Approved LORA input data files and output reports shall be delivered in accordance with CDRL specified delivery mode (i.e., deliverable digital media or on-line access/retrieval).

SOW Para. 6.0 Diagnostics

The source of diagnostic information will reside in logistics engineering data bases offering data exchange in neutral formats. Software shall be developed to provide for automated interface with in-service performance and maintenance data collection processes and to provide feedback concerning successes and failures in the fault isolation process to the [program] system designer. Diagnostic systems that learn from experience and which have the capability to update a knowledge-based diagnostic data base to optimize the fault isolation process or to improve system design are to be used to the fullest extent possible.

SOW Para. 7.0 Management Information Tools

The contractor shall establish an on-line direct access capability for recording, planning, scheduling, and reporting status of program requirements. This shall provide visibility of the contractor's performance, highlight potential problems, and provide schedule compatibility checks to ensure integration of functional activities. This on-line capability shall identify change impacts on related areas of logistic support, design and manufacturing, and provide the status of program deliverables.

SOW Para. 8.0 Technical Manuals

The contractor shall provide for computer assisted generation of technical manuals/orders. This data is to be derived, to the maximum extent possible, from integrated digital data files, e.g., CAD/Engineering Data Base/LSAR. This data shall be provided in accordance with (Service-unique specifications and TM/TO development guidance or other TM/TO SOW requirements).

SOW Para. 9.0 Supply Support

The contractor shall maintain spare parts identification consistent with the approved configuration baseline and allow for on-line assessment of the impact to spare parts requirements during analysis of design alternatives. The contractor shall provide provisioning technical documentation in accordance with MIL-STD-1388-2 to facilitate automated ordering, supply management, and distribution, and should provide on-line identification of spares, repair parts, and source/maintenance/recoverability coding. This data shall be provided IAW (Service-in unique specifications and TM/TO development guidance or other TM/TO SOW requirement).

SOW Para. 10.0 Facilities Data

The contractor shall provide facilities data in digital form in accordance with MIL-STD-1840A consistent with data derived from the LSAR data base. Engineering drawings and specifications shall be provided in accordance with paragraphs 4.0.

SOW Para. 11.0 Training

Training data should be developed in accordance with MIL-STD-1388-2, MIL-STD-1379 and MIL-HDBK-292. The LSAR data base shall provide source data to MIL-STD-1379 program software for producing output reports and instructional materials. Authorized system software shall be in accordance with GCO specified requirements.

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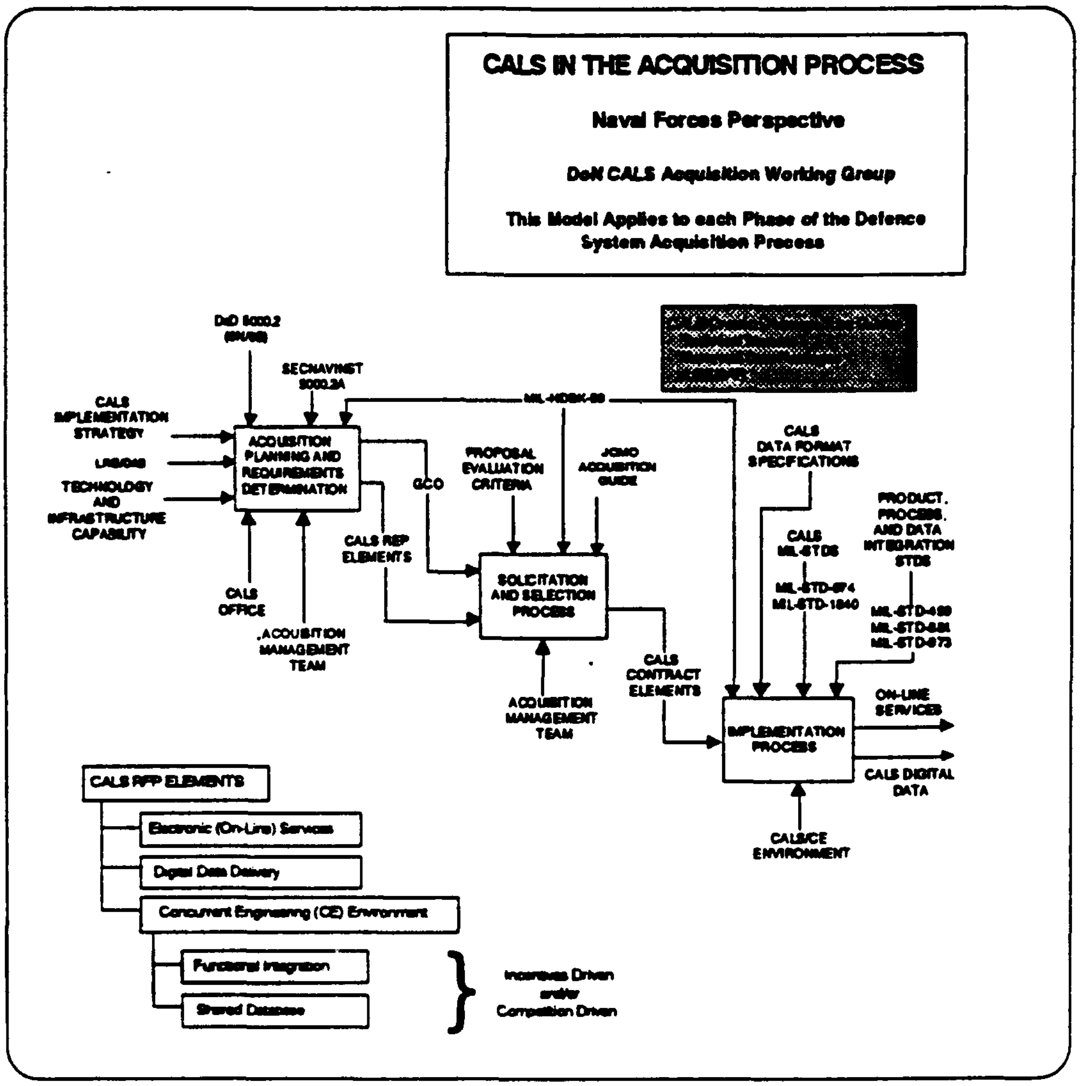
GUIDE CONTENTS

SECTION 6

Applying CALS To The Creation, Management, And Use Of Technical Data Packages



APPLYING CALS TO THE CREATION, MANAGEMENT, AND USE OF TECHNICAL DATA PACKAGES

SECOND EDITION

30 June 1993

Prepared by:
CALS Resource and Implementation Cooperative (CALS RIC)

Prepared for:
Navy CALS Acquisition/ Implementation Group

FOREWORD

Purpose

The Navy Computer-aided Acquisition and Logistic Support (CALS) Acquisition/Implementation Sub-Group has charged the CALS Resource Implementation Cooperative (RIC) with developing acquisition guidance for each of the three process architectures defined in the Navy CALS Acquisition/Implementation Plan. This document is the result of an exhaustive search and distillation of information pertinent to applying CALS to the creation, management, and use of Technical Data Packages (TDPs). The intended audience of this document is Navy/Marine Corps Acquisition Managers, project engineers, and project logisticians. This document lends itself to incorporation into specific Naval Forces System Command and Marine Corps program manager guides for applying CALS to defense system procurements.

Scope

The three process architectures described in the Naval Forces CALS Architecture and Environment are:

- Engineering Drawings
- Technical Manuals
- Logistic Support Analysis Record (LSAR).

This revision has been expanded to include:

- Cost/Pricing Matrix
- Proposal Evaluation Criteria
- Discussion on Contractor Integrated Technical Information Service (CITIS)
- Decision Oriented Templates.

Overview

Section 3.0, *General Considerations*, provides topics of consideration that must be addressed by the Acquisition Manager pertaining to the application of the CALS strategy to technical data packages. This section covers the following considerations:

- TDP Elements
- TDP Decision and Responsibility
- Identifying/Establishing a TDP Requirement
- TDPs in the CALS Environment
- CALS Requirement Documents
- Navy Infrastructure Development
- Data Uses.

Section 4.0, *Specific Considerations*, uses these topics as a basis to address additional requirements when acquiring TDPs in a CALS environment such as selection of data formats and delivery media and cost considerations. Sample contract language is also provided.

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TABLE OF CONTENTS

Appendixes A, B, and C as referenced in this document are in the back of the Desktop Guide.

FIGURES

TABLES

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1.0 INTRODUCTION

Computer-aided Acquisition and Logistic Support (CALS) is a Department of Defense (DoD) strategy that will enable more effective creation, management, exchange and use of data to acquire and support defense systems and equipment. Technical data packages (TDPs) contain the information necessary to describe a defense system and its components in terms of design, engineering, manufacturing, and logistics support. Applying CALS to the creation, management, and use of TDPs will aid in accomplishing the transition from paper-intensive defense system acquisition and support processes to an automated and integrated digital process.

It should be noted that the application of CALS-related technologies to Navy processes should be seen as a means of improving and streamlining these processes by providing better methods of creating, managing, and using data, not as a method of replacing business practices.

1.1 Scope

It is recognized that each defense system program is unique with individual constraints and access to a distinct set of infrastructure systems. This document is intended to provide the Navy/Marine Corps Acquisition Manager with an overview of Navy business practices for the creation, management, and use of TDPs in a CALS environment. Specific implementation of this process follows the completion of the Government Concept of Operation (GCO) and may be tailored.

1.2 Purpose

The planning process for the creation, management, and use of TDPs in a CALS environment needs to take advantage of the capabilities provided by the automation and integration of information systems. Various data content, media, and format options are available for the delivery of digital TDPs needed to define and support a defense system. The intent of this document is to:

- Describe the various deliverable content, format, and media options for TDPs
- Explain the benefits and caveats for the available options
- Examine the life cycle considerations for all options
- Describe the infrastructure of documentation and systems available to support the various options
- Provide a method to determine the cost associated with each option
- Provide guidance for specific contract language required to support the selection of the options
- Describe contractor validation and Government verification procedures.

This document contains ordering information for the deliverable media and digital data format for TDPs. The guidance in this document addresses the delivery consideration of TDPs as defined in MIL-T-31000. The Contract Data Requirements List (CDRL) guidance contained in this document applies to all TDP elements.

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2.0 REFERENCES

2.1 Acronyms

A complete list of acronyms used throughout the desktop guide is in Appendix A. The following acronyms are used in this section of the guide.

2-D	2-Dimension
3-D	3-Dimension
AIM	Advanced Industrial Management
ANSI	American National Standard Institute
ASCII	American Standards Code for Information Interchange
ATIS	Advanced Technical Information System
CAD	Computer Aided Design
CAD-2	Computer-Aided Design (Second Acquisition)
CAE	Computer Aided Engineering
CALS	Computer-aided Acquisition and Logistic Support
CALS RIC	CALS Resource and Implementation Cooperative
CALSIP	CALS Implementation Plan
CAM	Computer Aided Manufacturing
CCITT	International Consultative Committee on Telegraphy and Telephony
CD-ROM	Compact Disk - Read Only Memory
CDRL	Contract Data Requirements List
CE	Concept Exploration
CGM	Computer Graphics Metafile
CITIS	Contractor Integrated Technical Information Service
CIVR	Configuration Item Verification Review
CLIN	Contract Line Item Number
COTS	Commercial Off-The-Shelf
CTN	CALS Test Network
DDN	Defense Data Network
DID	Data Item Description
DoD	Department of Defense
DoDD	DoD Directive
DoDI	DoD Instruction
DTD	Document Type Definition
EDI	Electronic Data Interchange
EDIF	Electronic Data Interchange Format
EDMICS	Engineering Data Management Information and Control System (see JEDMICS)
ELIN	Exhibit Line Item Number
EM&D	Engineering, Manufacturing, and Development
FOSI	Formatting Output Specification Instance
GCO	Government Concept of Operation
GFI	Government-Furnished Information
IAW	In Accordance With
IGES	Initial Graphics Exchange Specification
ILS	Integrated Logistics Support
IPC	Institute for Interconnecting and Packaging
IPO	IGES/PDES Organization
ISO	International Organization for Standardization

JEDMICS	Joint Engineering Data Management Information and Control System
LAN	Local Area Network
LSAR	Logistics Support Analysis Record
MEDALS	DoD Military Engineering Drawing Asset Locator System
NDI	Nondevelopmental Item
NEDALS	Navy Engineering Drawing Asset Locator System
OCR	Optical Character Recognition
OS	Output Specification
PCA	Physical Configuration Audit
PDES	Product Data Exchange using STEP
PDL	Page Description Language
POSIX	Portable Operating System Interface
RDT & E	Research, Development, Test and Evaluation
SGML	Standard Generalized Markup Language
SIE	Special Inspection Equipment
SNAP	Shipboard Non-technical ADP Program
SOW	Statement of Work
SPA	Solicitation Package Automation
SQL	Standard Query Language
STEP	Standard for the Exchange of Product data
TDP	Technical Data Package
VHDL	VHSIC Hardware Description Language
VHSIC	Very High Speed Integrated Circuit
WAN	Wide Area Network
WORM	Write Once/Read Many times

2.2 Definitions

Definitions used in this section and throughout the desktop guide are in the Definitions section of Appendix A.

2.3 Applicable Documents

Documents referenced in this section and throughout the desktop guide are listed in Appendix A: Applicable Documents.

3.0 GENERAL CONSIDERATIONS

The development of an acquisition strategy for TDPs needs to be carefully examined to maximize the value for a specific defense system program. Program development elements such as technology, costs, end-item quantities, and schedules have a profound effect on the delivery requirements for supporting TDPs. Therefore, Acquisition Managers must consider the life cycle of the procurement and the existing and planned Navy infrastructure to support the TDPs for their program.

The following sections discuss topics of consideration that must be addressed:

- TDP Elements
- TDP Decision and Responsibility
- Identifying/Establishing a TDP Requirement
- TDPs in the CALS Environment
- CALS Requirer..ent Documents
- Infrastructure Development
- Data Uses.

Section 4.0, *Specific Considerations*, uses these topics as a basis to discuss specific requirements when acquiring TDPs in a digital environment such as: selection of data formats and delivery media; cost considerations; and specific contract sample language.

3.1 TDP Elements

TDP elements may be grouped in terms of data construction as: (1) Drawings and associated lists, (2) illustrated text documents, and (3) product data. The drawings and associated lists group is data that primarily consists of illustrations that describe a product or process interspersed with small amounts of text that help explain the elements of the product or process. The illustrated text document is data that primarily consists of text. In some cases graphics may be present, but they usually consist of simple illustrations, figures, or tables. Product data includes 3-D information, such as product models that contain the digital information required for full product definition (see Appendix B: Product Data).

3.1.1 Drawings and Associated Lists

Each of the types of drawings listed below provide the data necessary to describe a particular item or product in terms of illustrations and text. However, in terms of digital data delivery, all of these drawings may be delivered by either of the following methods: (1) Raster image files or (2) processable data files, which in this case refers to vector data files, e.g. native Computer Aided Design (CAD) or Initial Graphics Exchange Specification (IGES).

- Conceptual Design Drawings
- Developmental Design Drawings
- Product Drawings
- Commercial Drawings
- Special Inspection Equipment (SIE) Drawings
- Special Tooling Drawings

3.1.2 Illustrated Text Documentation

Each of the types of documentation listed below provide the data necessary to describe a program or product in terms of text and simple graphics. However, in terms of digital delivery, all of these documents may be delivered by any of the following methods: (1) Raster image files; (2) processable data files, which in this case means text files; or (3) Contractor Integrated Technical Information Service (CITIS).

- Specifications
- Software and Software Documentation
- Test Requirements Documents
- SIE Operating Instructions
- SIE Descriptive Documentation
- SIE Calibration Procedures
- Preservation, Packaging, Packing, and Marking Data
- Quality Engineering Planning List

3.2 TDP Decision and Responsibility

The following sections of this document are devoted to the acquisition of TDPs in a digital environment. The purpose of the flow chart (see figure 1) is to lead an Acquisition Manager through a logical series of decisions designed to provide the basis for TDP format and delivery media selection. Cost comparison information and recommended CDRL language is also provided.

The flow chart also recommends who specifically is accountable for performing each task, function, or making a decision. In addition to identifying the responsible agency or agent for each of the tasks, functions, or decisions, this chart also identifies supporting agencies and their inputs as required. In many cases, these are the same entity.

NOTE: Shadowed task/function boxes alert the user of additional details and/or decision flow charts.

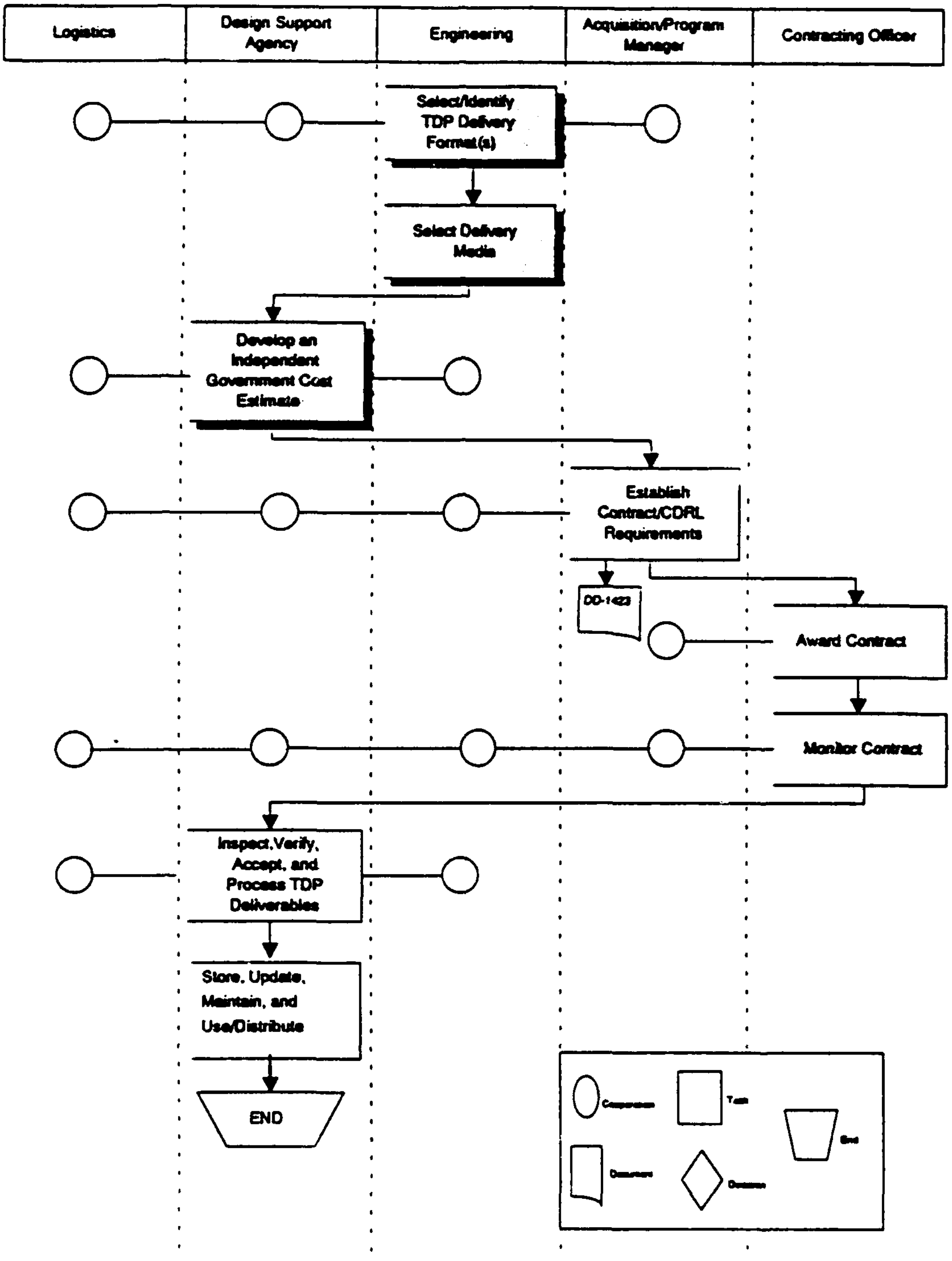


FIGURE 1. TDP Decision and Responsibility Flow Chart

3.3 TDPs in the CALS Environment

The CALS strategy provides the Acquisition Manager with a framework of standards, specifications, and systems (see Appendix C: Navy Infrastructure Modernization Programs) to create, manage, and use information in a digital environment. The Acquisition Manager should recognize the importance of requiring digital data deliverables. The benefits associated with using digital data far exceed what is being discussed in this document. For TDPs, two benefits of digital data include: (1) Improving the handling and reducing the storage of TDP data, primarily engineering drawings, with electronic filing and archiving, ideally creating a data repository (see Appendix C: JEDMICS); and (2) reducing the costs associated with printing and distributing TDP data, especially during the development stages, by providing on-line access (CITIS) (see Appendix A) to contractor databases, so that the Government procuring agency could access specific TDP data required by using any of the methods described in MIL-HDBK-59 (see 3.8).

Please note that due to the intensive infrastructure modernization efforts (see Appendix C) underway within the Navy and other services, this document does not consider delivery of a TDP in other than digital format justifiable. References to nondigital data deliverables are only made in conjunction with the delivery of a digital product and for the sole purpose of verifying the quality and accuracy of the digital transfer of data between the various digital systems.

A brief discussion of both nondigital and digital data deliverables is provided. The nondigital deliverables will not be addressed again in this document since their importance in a CALS environment is minimal. The digital deliverables will be mentioned here providing a brief overview of options available to the Acquisition Manager. A more thorough discussion will be provided in section 4.0.

3.3.1 Nondigital Data Deliverables (Originals and Reproducibles)

3.3.1.1 Paper, Mylar Hardcopy

Paper or mylar hardcopy has long been the traditional media for delivery of Navy product data and related information. TDPs delivered on this medium may have originated from many sources including other existing hardcopy documentation, microfiche, microfilm, or any of the digital data formats described in the following sections. Converting the data content of paper to a digital data format requires infrastructure systems that include scanning hardware and software to support the conversion of both text and graphics from hardcopy to electronic format. The Joint Engineering Data Management Information and Control System (JEDMICS) supports this type of paper to digital format conversion process (see Appendix C: JEDMICS).

NOTE: The Acquisition Manager today should accept hardcopy TDP deliverables only for the purpose of verifying the digital deliverables.

3.3.1.2 Aperture Cards

Aperture cards is the traditional medium for delivery of the TDP to the Navy. Aperture cards contain engineering drawings on microfilm and associated engineering metadata in digital punch-card formats. The data provided on aperture cards are governed by specifications, such as MIL-M-38761/2, MIL-C-9877, MIL-M-38748, and MIL-M-9868, which provide guidelines for data format and content. Because aperture cards contain both microfilm media and digital punch-card data, specialized infrastructure requirements are necessary to use this media. Single-purpose systems are currently in use to extract the data from aperture cards. In addition, converting the data contents of aperture cards to a more flexible digital data format would require additional infrastructure requirements that would include scanning hardware and software to support both text and graphics. JEDMICS supports the conversion of aperture card images and data to raster form (see Appendix C: JEDMICS).

3.3.2 Digital Data Deliverables

Digital data deliverables available in the CALS environment are extensive. Digital data provides the Acquisition Manager with a variety of digital data content, formats and media options. They include the following.

Data Content:

- Drawing Data
- Product Data
- Illustrated Text Documents

Data Formats:

- Text
  a. Raster
  b. Unintelligent Text (ASCII)
  c. Intelligent Text (SGML tags, Illustrations, etc.)

- Image Data
  a. Raster
  b. Native CAD
  c. Neutral (IGES)

Media:

- Magnetic tape
- Magnetic disk
- Optical disk
- CITIS - interactive on-line access
- CD-ROM

3.4 Life Cycle Considerations

As a defense system develops through its life cycle, TDP deliverable requirements may vary. In addition, the availability as well as the volume and format of the data generated by the contractor changes. The Acquisition Manager must be prepared to adjust the contract data requirements to meet the needs of all organizations involved in the procurement and support of the defense system. Often new contracts are issued at the Engineering & Manufacturing Development (E&MD) (Phase II) and Production and Deployment (Phase III) phases of the acquisition program; therefore, the Acquisition Manager must anticipate the upcoming contract and be prepared to alter the data requirements in the procurement documents. The Acquisition Manager must also consider the information volume and typical use (see 3.8) of the particular TDP element selected. To take advantage of the CALS strategy, **data must be created and/or obtained in a digital form during the earliest possible program phase.** By starting early, product information created during the Concept Exploration (CE) and Definition (Phase 0) phase may be used repeatedly throughout the life cycle. **Failure to develop data in a digital form early in a program can lead to requirements for costly data conversion and will deny potential benefits from digital data exchange.**

3.4.1 Contract Data Requirements List (CDRL)

Standard practices of human observation, interpretation, and review must be used to determine whether data presentation, format, and technical content meet contractual requirements as specified in the CDRL. The transfer media is to be verified by human observation, interpretation, and review (see figure 2).

CONTRACT DATA REQUIREMENTS LIST (Data Item)	Form Approved OMB No. 0704-0188

[illegible]

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY TDP __X__ TM _____ OTHER _______

D. SYSTEM/ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE
	PRODUCT DRAWINGS AND ASSOCIATED LISTS	REVIEW COPY OF PRODUCT DRAWINGS ELIN (ADD DATA ITEM NO.)

4. AUTHORITY (Data Acquisition Document No.)	5. CONTRACT REFERENCE	6. REQUIRING OFFICE
SEE BLK 16		

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION
DD	SEE BLK 16		
8. APP CODE		11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION
A			

14. DISTRIBUTION			
a. ADDRESSEE	b. COPIES		
	Draft	Final	
		Reg	Repro
SEE BLK 16			
15. TOTAL			

16. REMARKS

BLK 4: DI-DRPR-81000, DD FORM 2554-1 WITH DENOTED ATTACHMENTS AND MIL-D-5480 (ADD TYPE, CLASS AND KIND).

BLK 8: APPROVAL SHALL BE BASED ON COMPLIANCE WITH DI-DRPR-81000, MIL-T-31000, DD FORM 2554-1 AND ATTACHMENTS DENOTED HEREON.. (ADD TIME REQUIRED FOR GOVERNMENT APPROVAL AND TURNAROUND TIME FOR CONTRACTOR TO RESUBMIT DATA TO GOVERNMENT)

BLK 9: TECHNICAL DATA SHALL BE MARKED (DISTRIBUTION STATEMENT AND EXPORT CONTROL WARNING NOTICE) IAW MIL-STD-1806, MIL-STD-100 AND CDRL SUPPLEMENT ATTACHMENT. VENDOR ITEM DRAWINGS SHALL BE USED-ON BLOCK IS BLANK, OTHERWISE ALL REMAINING DRAWINGS SHALL BE DISTRIBUTION SUPPLEMENT____ (SPECIFY LETTER).

BLK 14: DISTRIBUTION SHALL BE IAW CDRL SUPPLEMENT ATTACHMENT..

THIS IS A SAMPLE CDRL. INFORMATION SHOULD BE TAILORED TO REFLECT PROGRAM REQUIREMENTS.

NOTES: (1) COMPLETE THIS FORM IAW INSTRUCTIONS FOR COMPLETING DD FORM AND DOD 5010.12-M (CHAPTER 3). (2) COMPLETE DD FORM 2554-1 IAW MIL-T-31000 AND ATTACH TO THIS FORM. (ENTER DIGITAL DATA SPECIFICATION, EXCHANGE MEDIA, ETC., INTO BLOCK 1.C.) (3) COMPLETE ATTACHMENT(S) FOR DD FORM 2554-1 AND CDRL SUPPLEMENT TO ACCOMPANY THIS FORM.

G. PREPARED BY	H. DATE	I. APPROVED BY	J. DATE

DD FORM 1423-1 JUN 90

FIGURE 2. Sample CDRL for Review Copies of Drawings

3.5 CALS Requirements

Standards and specifications have been developed and are continuing to be developed to assist in providing a baseline of standardization to the CALS strategies and processes. These documents provide the policies and procedures to define and coordinate data acquisition during development of new, and maintenance of existing defense systems. Figure 3 provides a chart displaying the relationship of each of the CALS documents to data acquisition. CALS standards and specifications pertaining to the acquisition of TDPs are included in Appendix A.

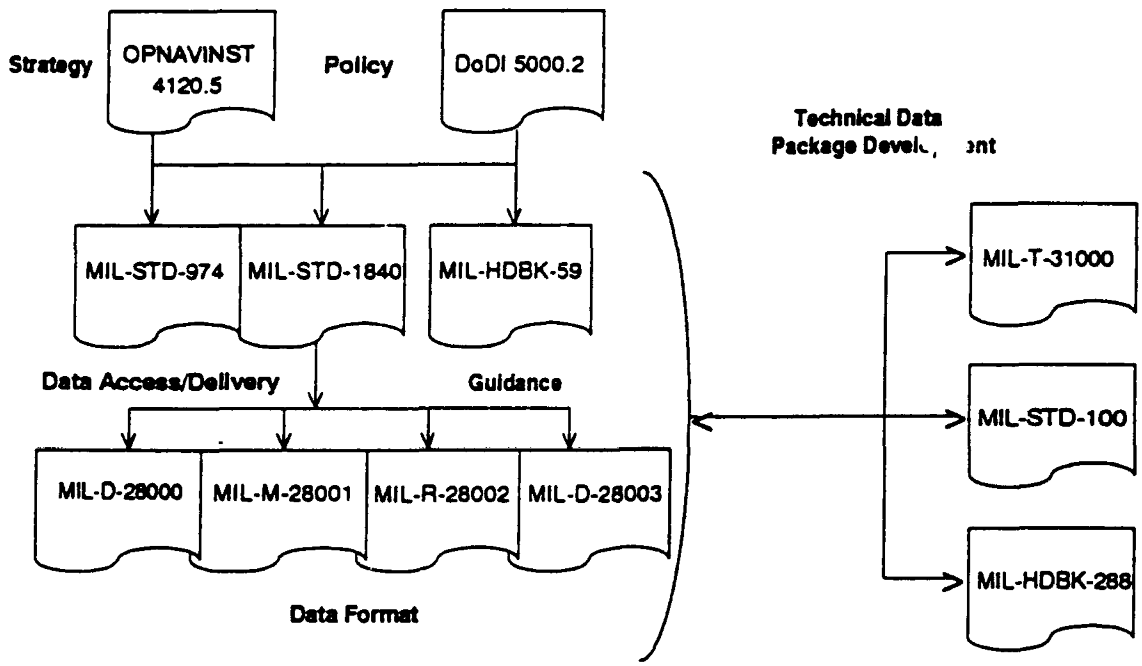


FIGURE 3. CALS Documents Relationship

3.6 Infrastructure Development

Effective acquisition of digital data can only be done with full consideration of the ability of Naval/Marine activities to receive, store, distribute, and use the digital data that complies with the CALS standards. The Acquisition Manager must establish the uses for which the data is required (see 3.8) and the infrastructure modernization programs (see Appendix C) available to support this data. In response to DoDI 5000.2, DoD components are incrementally upgrading the infrastructure toward a comprehensive technical information management architecture through joint service programs like JEDMICS (see Appendix C). The evolution of this infrastructure is a key consideration in implementing the CALS strategy on any given acquisition. Deficiencies in program related infrastructure may require cost investments by the acquisition management team to effectively implement the CALS strategy.

The availability of digital data processing and telecommunications technology and approved standards for creation management, storage management, transmission, data protection, and integrity of data at the time of delivery or access are important criteria for acquisition decisions. The current and projected capabilities of both the

contractor and Naval Forces components must be assessed with respect to program needs and schedules. The Government Concept of Operation (GCO), its 'Contractor's approach to CALS Implementation' counterpart, and CALSIP (when required), are excellent vehicles for making these determinations. Acquisition managers must plan to acquire and/or access digital data products.

The data user infrastructure, the computing environment available to a particular user, must be considered when acquiring digital data. This environment establishes the data processing capabilities of that user. The following areas identify a user's infrastructure:

- Hardware: Determine the current and planned hardware available to support the defense system program.

- Software: This is the most critical element. Interoperability will normally be achieved through the use of software. Again, determine both present and future software applications and availability.

- Networks: Determine the local- and wide-area networking (LAN and WAN) capabilities and whether CITIS will be used.

The Navy infrastructure modernization programs specifically designed to aid in the creation, management, and use of TDPs are:

- CAD-2: Computer-Aided Design (Second Acquisition)

- JEDMICS: Joint Engineering Data Management Information and Control System

- NEDALS: Navy Engineering Drawing Asset Locator System

- AIM: Advanced Industrial Management

- ATIS: Advanced Technical Information System.

An overview of these information management infrastructure programs is contained in Appendix C.

3.7 Data Uses

Technical data packages are subject to all uses defined in MIL-HDBK-59. The Acquisition Manager will need to identify the use of the data by all organizations involved in the acquisition program. The Acquisition Manager must consider how data will be processed in order to make good decisions on digital data requirements. The five categories of data processing typical of most defense system programs are:

- View only: The ability to examine a data file without the ability to change it. This includes viewing selected portions of one or several documents as well as side-by-side comparisons of documents. This activity is an excellent candidate for applying the CITIS concept.

- Comment/Annotate: The ability to evaluate and highlight for future reference or to make annotations, approvals, and comments without the ability to change the original file. Annotations are associated with a specific item or location within a document and are displayed whenever that point or area of the document is displayed. Core CITIS functions (approve, comment, view) are intended to provide this capability and should be given consideration.

- Update/Maintain: The ability to change data either directly or through controlling software in the active files on the host computer.

- Extract/Process/Transform: The ability to extract and modify the format, composition, and structure of the data into another usable form.

- Archive: The placing of data into a repository to preserve it for future use.

The interchange of text type data that traditionally has been conveyed on paper can be transmitted or communicated electronically using the established rules and formats of Electronic Data Interchange (EDI). The Federal Information Processing Standard (FIPS) publication FIPS-PUB-161 for EDI is recognized as the international standard for the electronic transmission of data associated with functional documents, such as a purchase order or invoice.

4.0 SPECIFIC CONSIDERATIONS

4.1 TDP Delivery

The purpose of this section is to determine the status and/or existence of a TDP and ultimately to lead the Acquisition Manager to a decision as to the specific type of digital data and media format required to support his or her program. In addition to the immediate TDP requirements (acquire and/or develop an end item or system), the Acquisition Manager should consider the potential long term engineering and support functions and requirements for technical data when selecting TDP formats.

4.1.1 Potential TDP Delivery Options

While actual delivery may include a mixture of options, TDP information falls into three distinctly different delivery forms:

- Document (drawing image): Hard copy (nondigital discussed in 3.4.1) or digital images (raster).

- Processable Data Files: CAD data and Computer Aided Engineering (CAE) systems create vector graphic files that define the geometry and associated data attributes of defense systems assemblies, subassemblies, and components. Data generated in this manner is capable of being updated; hence, the files containing data are processable. In defense system development contracts, digital delivery of processable data files is preferred and should be considered the standard of communication between the contractor and the Government.

- CITIS interactive access: Consult MIL-STD-974 for interactive access/delivery options.

4.1.1.1 Raster

Raster data is a binary representation of an image. Raster may be thought of as the electronic version of a paper document. It contains no "intelligence" and must be reviewed through human interpretation. There are two types of raster data, tiled and untiled. Tiled raster is the preferred format because of smaller file size. A tiled raster image resembles a two-dimensional grid with each "tile" or set of pixels representing a portion of the image. Text and graphics in raster data formats are stored digitally, which allows more rapid and consistent access to the stored images than paper. In addition, raster data can be sent via electronic means to remote sites. Raster files can be edited in several ways:

- Raster Edit: The manipulation of individual pixels or pixel groups
- Vector Overlay: Hybrid editing where vectors are overlaid onto a raster file (both the raster and vector are stored as the final image)
- Raster to Vector Conversion: Conversion of pixel groups to vector primitives.

Raster documents may be converted to unintelligent text via Optical Character Recognition (OCR) technology. The technology, however, is still in its infancy.

With the advent of raster scanning technologies, the ability to convert existing TDPs to digital data files has become available. However, the quality assurance process (by human interpretation) required to verify the data contents may increase costs substantially. Also, raster image files require a large amount of memory storage due to their file structure and contain no additional information other than each tile's position on a grid. Because of these drawbacks, the Acquisition Manager should consider processable data forms before considering raster unless the TDP will not be used for competitive reprocurement. JEDMICS stores drawing images as raster data on optical disk media and will accept tiled or untiled raster data (see Appendix C: JEDMICS).

4.1.1.2 Processable Data Files

Processable data files provide the majority of options available for digital TDP delivery. Processable data files can be broken down into two additional categories, drawing and product data files and text data files. These categories are considered processable, because the data can be manipulated by the user, interpreted by the computer, and reprocessed into an updated or new form as specified by the user.

4.1.1.2.1 Drawing and Product Data Files

Drawing data files, the output of CAD systems, comprise vector data, and as the name "vector" implies, the image produced is composed of vectors, a sequence of line segments. Vector data provides geometrical and physical representation of objects in both two and three dimensions. Vector data files are stored digitally allowing rapid retrieval and integration into other compatible systems. Because the data consists of a sequence of line segments and patterns/symbols that represent entities with specific orientation and location, vector data can be translated to code interpreted by some automated machine tools. Drawings delivered in this format must conform to IGES Class II (MIL-D-28000) unless the native vector CAD files are available in an agreed-to, compatible format. (The user of native vector data must have the same type of CAD system or must have a direct translator from the source system to the using system.) The native CAD format is the preferred format during early development phases in the defense system program's life cycle, because the translation to IGES will invariably exclude some of the data inherent in the native CAD files. If vector data is not compatible between the user and the source, then the IGES standard should be delivered, as it does allow dissimilar CAD systems to manipulate vector data. Final delivery, however, must be in IGES. CAD-2 supports vector data in IGES formats (see Appendix C: CAD-2).

Note: There are no commercial or Government standards for preparing 3-D CAD models. As a result, repository systems may not have the capability to store usable 3-D CAD products.

Acquisition Managers should consider acquiring the portion of the drawing package developed from 3-D modeling.

Product data is the most comprehensive form of digital data. Product data contains all information needed to describe a product completely, and a large portion of this information can be directly interpreted by a computer. Product data allows the

simulation of systems modifications prior to implementation and evaluation of form, fit and function performance of components. In addition, product data with its inherent *intelligence can be used to drive manufacturing processes.*

4.1.1.2.2 Illustrated Text Data Files

Illustrated text data files provide a dynamic form of source data with two possibilities: (1) Separated files for text, graphics, alphanumeric, and audio/visual data; or (2) integrated files consolidating some or all of these different data representations. Text data files include word processing and desk top publishing applications. Such data files can provide the source data for multiple data applications that allow creation of standard and custom documents as well as manipulation of the data for annotate/excerpt or update/maintain purposes. Text data files can also import generic text [ASCII, SGML (MIL-M-28001), etc.] and graphics [raster (MIL-R-28002), CGM (MIL-D-28003), IGES (MIL-D-28000), etc.] from other sources that may be otherwise incompatible. Also, there are Page Description Languages (PDLs), sometimes called text presentation metafiles, which are used to drive output devices such as printers.

There may be instances when obtaining text data files involves obtaining more than one format of graphical data. This may be due to multiple graphic sources. This is an acceptable and highly likely situation. The Acquisition Manager must be aware of this possibility and be prepared to develop/modify the defense system contract requirements accordingly.

Text Formats:

There are three possible text formats available for consideration when invoking the option specifying text data files. They are American Standards Code for Information Interchange (ASCII) and tagged ASCII, Standard Generalized Markup Language (SGML), or raster. They are described below.

- ASCII

  ASCII was developed as a method of translation for computer processors to interpret alphanumeric characters and symbols through binary representation. ASCII is the basic text information used by most wordprocessing applications and contains no formatting information other than line feed and/or carriage returns. Wordprocessing applications can import ASCII text from other wordprocessing applications, and some wordprocessing applications can translate formatted ASCII from other wordprocessing applications into their own format. This makes ASCII text ideal for most interim deliverables since it can also be imported into an SGML application where it can be SGML-tagged to become a CALS-compliant deliverable.

- SGML

  SGML as defined in MIL-M-28001 is "A standard that defines a language for document representation which formalizes markup and frees it of system and processing dependencies. It provides a coherent and unambiguous syntax for describing whatever a user chooses to identify within a document." In the SGML scheme, the document contains only generic tags identifying such

structural elements as paragraphs, sections, etc. but no typesetting markup. However, SGML's tagging of ASCII text is a rather cumbersome proposition and may be best suited for final data deliverables rather than interim deliverables. When considering SGML as a deliverable format, the Acquisition Manager must determine whether the necessary computer environment is available and in place to accept the SGML documentation. Additional features associated with SGML are described in Appendix A [Document Type Definition (DTD), Output Specification (OS), Formatting Output Specification Instance (FOSI)].

- Raster

  See 4.1.1.1 for a discussion of raster data.

Graphics and Illustration Formats:

There are many possible graphic image formats available for consideration when invoking the option of specifying text data files. Two suggested formats described below are Computer Graphics Metafile (CGM) and raster.

- CGM

  CGM data is a two dimensional vector presentation used primarily for charts, figures, and simple drawings. CGM requirements are stated in MIL-D-28003.

- Raster

  See 4.1.1.1 for a discussion of raster data.

Page Description Language (PDL):

A PDL file is executed by an interpreter that controls a raster printer or other output device. A PDL can be used to ensure that the composed document produced by an electronic publishing system (which may impose additional processing limitations, such as font variations, kerning, or hyphenation) would produce nearly identical hardcopy output on the widest possible spectrum of printer devices. MIL-STD-1840 provides for the interchange of PDL data files. However, PDLs are currently not standardized, for a Standard Page Description Language (SPDL) is still being developed. MIL-STD-1840 requires that a system must provide portability of files (e.g.: Postscript or Impress PDL specifications). PDL document image files can be acquired as interim deliverables or as final deliverables in addition to (but not in place of) other digital data deliverables.

4.2 Existing TDP Availability

Utilization of existing legacy data is quite common when new systems use features of older systems. The Acquisition Manager should be aware that, even on completely new defense system programs, some portion of the TDP may pre-exist (see figure 4). This is most relevant when a program is entering the Concept Exploration and Definition (Phase 0) and prior to Concept Demonstration Approval, Acquisition Milestone I. An important point to remember here is that acquisition of the proper level and type of digital data is most cost effective when defined early in the program's life cycle. Other potential considerations include: TDPs associated with

Nondevelopmental Items NDIs), Commercial Off-The-Shelf (COTS) acquisitions, and reverse engineering efforts. If the TDP does not exist and/or is not accessible to the Government, the Acquisition Manager should refer to the TDP development decision flow chart (see figure 5 and section 4.4). If a TDP does exist, the Acquisition Manager should proceed to 4.3 regarding the format of the TDP. Please note that for those cases where the TDP is under development but not yet completed, the Acquisition Manager also should proceeo to 4.3.

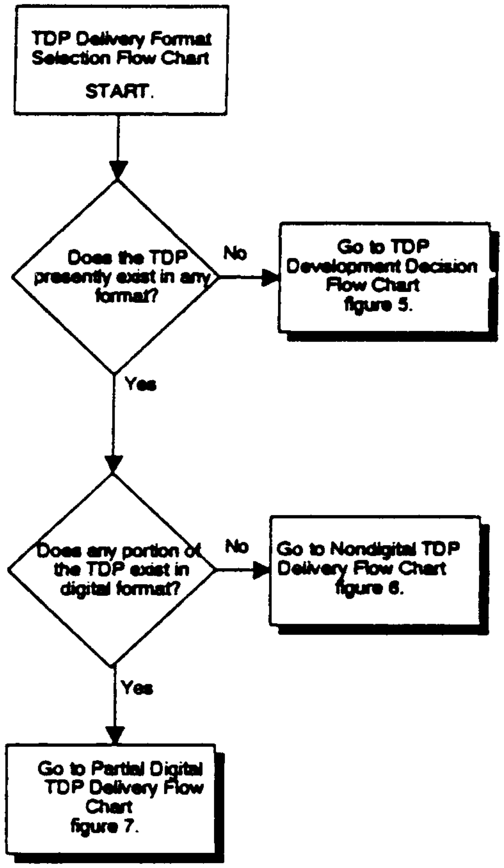


FIGURE 4. TDP Delivery Format Selection Flow Chart

4.3 TDP Format Determination

Assuming the existence of a TDP, the Acquisition Manager must consider whether any portion of the TDP exists in a digital format. Again, the purpose is to lead the Acquisition Manager into another series of questions to define further which digital delivery format best satisfies the defense system program objectives and requirements. Potential concerns here include: (1) TDPs associated with existing in-service items that may or may not be in digital format; (2) new TDPs that potentially could be developed in a nondigital format; and, most likely, (3) TDPs that are a varying mixture of digital and nondigital elements. If the TDP does not exist in a digital format, refer to figure 6 as you read the following sections. If the TDP does exist in a digital format, refer to figure 7 as you read the following sections.

4.4 TDP Development Decision

The Acquisition Manager must logically decide which TDP delivery format best fits the life cycle of the weapon system. This decision flow chart (see figure 5) is formed around the premise that the TDP will be delivered in some type of digital format with the only question being which format best fits the needs and requirements of the program.

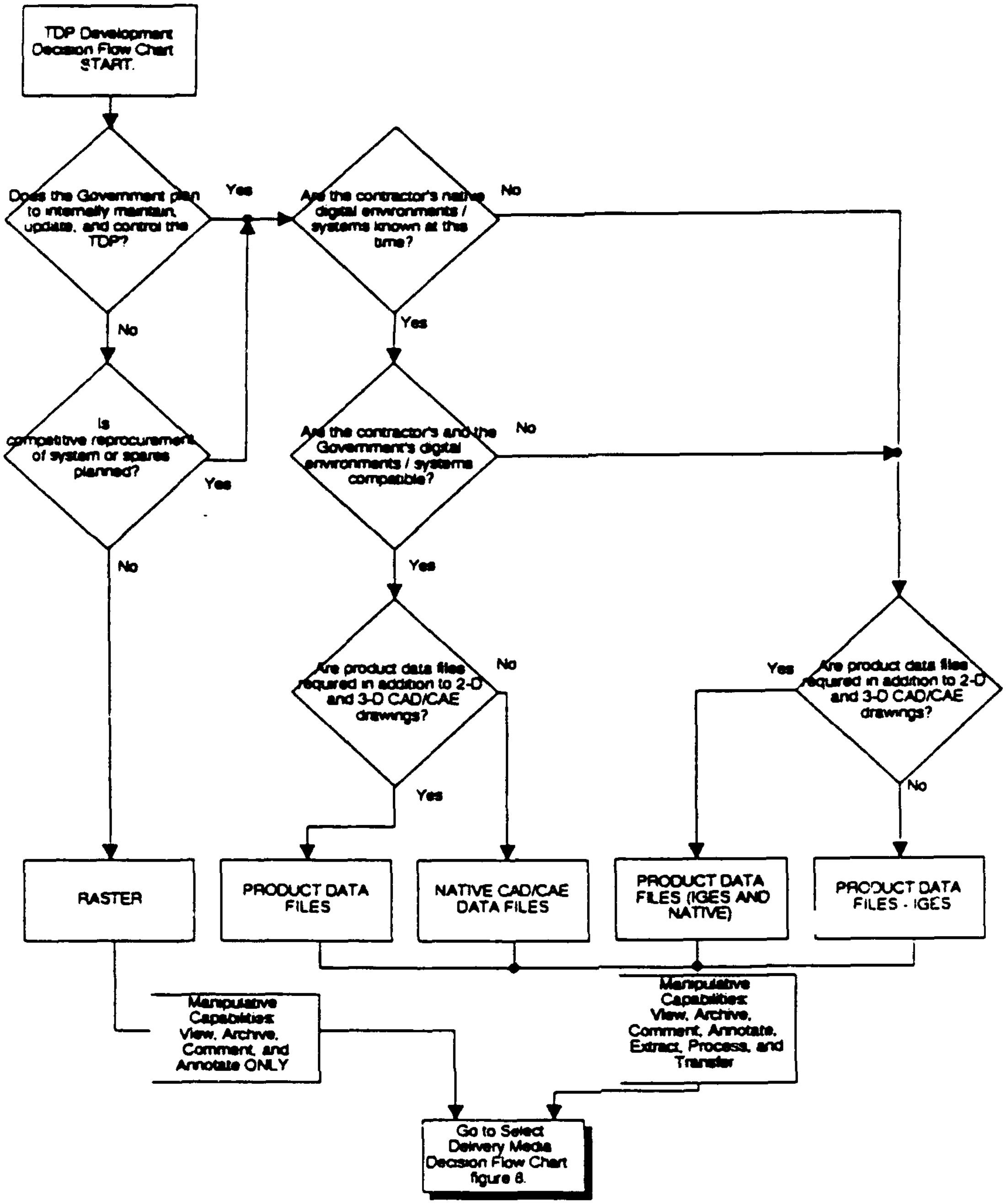


FIGURE 5. TDP Development Decision Flow Chart

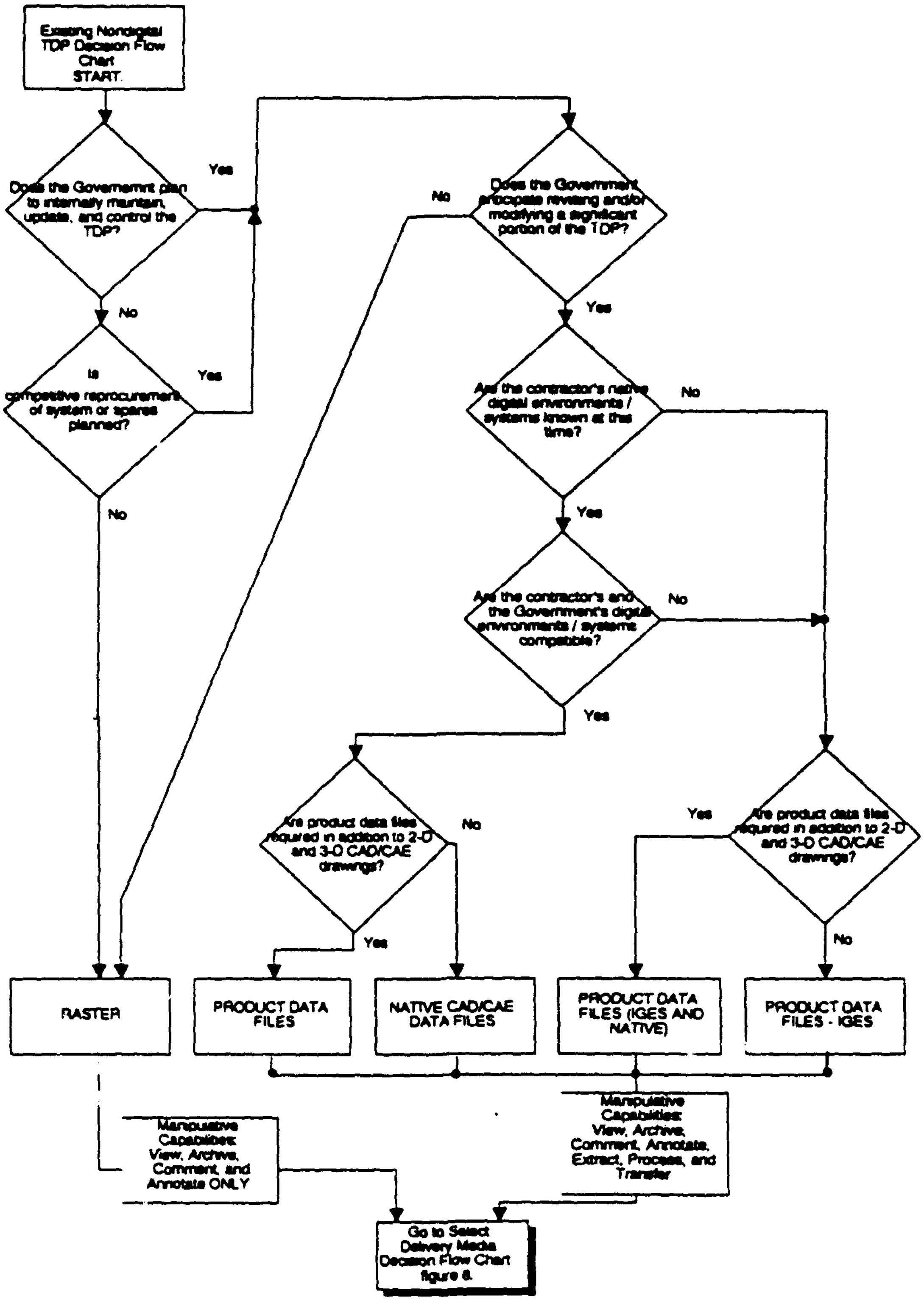


FIGURE 6. Nondigital TDP Delivery Decision Flow Chart

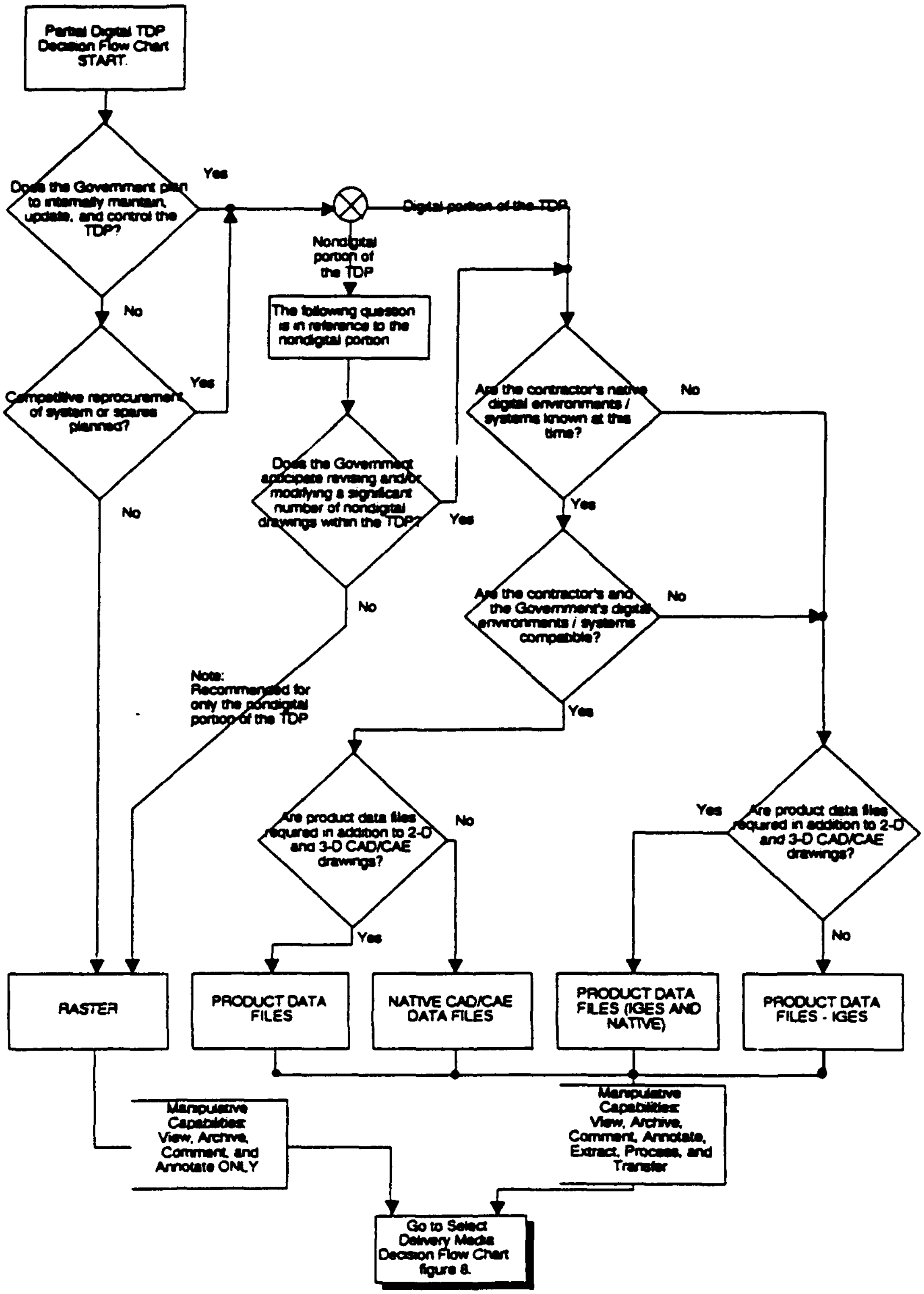


FIGURE 7. Partial Digital Format TDP Decision Flow Chart

4.4.1 Government Maintenance and Control of the TDP

The Acquisition Manager must consider whether the Government plans to maintain and control the TDP internally. This deals with the underlying issues of who will maintain and control the TDP once it has been delivered to the Government and how will they do it. It is assumed that the TDP will be developed in a digital environment, i.e. in a CAD/CAE environment. The key point to remember is that if the Government plans to maintain, update, and/or produce various configurations of the TDP in the future, the TDP should be delivered in an "intelligent" format, i.e. in processable data files including CAD/CAE files vice document image files such as raster format. Conversely, if the Government does not plan to "update or maintain" the TDP, it is recommended that the Acquisition Manager consider a raster-format-only delivery. If the Government plans to maintain and control the TDP internally, go directly to 4.4.3. Otherwise, go to 4.4.2.

Note: Delivery of a TDP in raster format does not eliminate on-line or electronic type review, comment, and annotation options during the TDP development cycle.

4.4.2 Competitive Reprocurement

The Acquisition Manager must consider whether competitive reprocurement of the system, spares, and follow-on support is planned. This prompts the Acquisition Manager to consider future requirements for the TDP. Competitive procurements, as addressed in the Acquisition Plan, can be significantly enhanced with the availability of "intelligent" digital information such as Government-Furnished Information (GFI) to the prospective bidders. If future acquisitions are not anticipated, cost associated with delivery of the TDP in a processable data file format may be unwarranted. If competitive reprocurement is planned, delivery of an "intelligent" format such as processable data files is recommended. In this case, go to 4.4.3. If competitive reprocurement is not planned, delivery of an "intelligent" data format may not be cost effective, and a raster format is recommended. In this case, go to 4.4.8.

4.4.3 TDP Modification/Revision Determination

Next the Acquisition Manager should consider whether the Government anticipates revising and/or modifying a significant portion of the TDP in the future. This applies only to the nondigital portion of the TDP. This prompts the Acquisition Manager to determine whether the nondigital portion of the TDP would serve the defense system program better in a digital format. If future manipulation of the data is not anticipated, raster delivery is the most suitable option. Proceed to 4.4.8. If the Government does plan to revise and/or modify the TDP, additional digital data considerations must be addressed. Go to 4.4.4.

4.4.4 Digital System/Environment

The Acquisition Manager should now determine whether the contractor's native digital environment/system is known at this time. This is focused at determining the most economical and efficient format for the various TDP components. (It is assumed that the Government has previously completed a GCO and identified the applicable Government in place infrastructure.) Obviously, for competitive procurements prior to source selection, the contractor's digital environment will not be known. This is, of

course, unless all prospective contractors have identical digital environment/systems. If the contractor's digital environment is not known, go to 4.4.7, which will consider the delivery of 2-D and 3-D CAD/CAE data files vice the delivery of a more comprehensive set of product data files. Otherwise, proceed to 4.4.5.

4.4.5 Digital System/Environment Compatibility

Next the Acquisition Manager must determine whether the contractor's and the Government's digital environments/systems are compatible. This focuses on the potential of transferring processable data files directly between two similar systems vice the transfer of data through a neutral data format such as IGES. Since the transfer of data between similar systems is typically less time consuming and is more accurate, this type of transfer is recommended. However, where the two systems are not similar, the transfer of data via a neutral format is recommended and/or quite necessary. If the digital environments are compatible, it is recommended that the transfer of data between the contractor and the Government be in the contractor's native format. Proceed to 4.4.6. If the digital environments are not compatible, it is recommended that a neutral format, such as IGES, be used to transfer data between the contractor and the Government. In this case go to 4.4.7.

4.4.6 TDP Data Requirements (Compatible Systems)

The Acquisition Manager should now determine whether product data files are required in addition to 2-D and 3-D CAD/CAE drawings. This draws the Acquisition Manager's attention to what specific elements of the TDP should be delivered to and/or made accessible to the Government. This is based on the assumption that the contractor's digital environment/system is compatible with the Government's.

Product data files will not be necessary if only 2-D and 3-D engineering drawings, parts lists, and specifications are required. In this case, go to 4.4.10. If it is determined that product data files are required, proceed to 4.4.9. Additional product data files that the Acquisition Manager should consider might include manufacturing data, simulation models and data, packaging data, etc. (see 4.1.1.2.1 NOTE).

4.4.7 TDP Data Requirements (Incompatible Systems)

The Acquisition Manager should now determine whether product data files are required in addition to 2-D and 3-D CAD/CAE drawings. This draws the Acquisition Manager's attention to what specific elements of the TDP should be delivered to and/or made accessible to the Government. This is based on the assumption that the contractor's digital environment/system is either unknown or is different from the Government's.

Product data files will not be necessary if only 2-D and 3-D engineering drawings, parts lists, and specifications are required. In this case, go to 4.4.11. If product data files are required, proceed to 4.4.9. Additional product data files that the Acquisition Manager should consider might include manufacturing data, simulation models and data, packaging data, etc. (see 4.1.1.2.1 NOTE).

4.4.8 Raster Delivery Option

The raster delivery option (see figure 8), which is described in section 4.1.1.1, allows the Acquisition Manager to obtain TDP data in a digital format. The data uses of the raster deliverable are somewhat limited but do provide for view, archive, comment, and annotate capabilities. Suggested delivery media options include: (1) Optical disk or CD-ROM, (2) magnetic disk, or (3) 9-track magnetic tape, all in accordance with MIL-STD-1840. Paper documentation may be requested in addition to the raster deliverables but only for verification of the raster data content.

4.4.8.1 Cost

Once raster has been selected as the data delivery format, the cost of acquiring this data can be calculated. A chart (see figure 9) has been developed to assist the Acquisition Manager in estimating this cost. This six-step process includes cost estimates for both raster and paper deliverables. If paper deliverables are not required for verification as in the early stages of the defense system's life cycle, they may be left out of the cost estimate by skipping step 3.

Note: This chart will provide an approximation of costs associated with this data deliverable. Specific program requirements, especially labor rates, may vary from those presented here and may be substituted for the rates shown.

4.4.8.2 CDRLs

To invoke this data deliverable option, specific CDRLs (see figures 10 through 14) have been developed to be used as examples. The information contained in these contract vehicles should be tailored to meet the requirements of the specific defense system program. The CDRL(s) must include language that specifies <u>exactly</u> how data will be delivered (including media, format, and content) under the contract. CALS standards and specifications should be invoked whenever possible.

4.4.9 Product Data File Delivery Option

Product data files (see figure 8) consist of a variety of data delivery options including product data files, text data files, and Product Data Exchange using Standard for the Exchange of Product data (PDES). PDES, which has been included in figure 8, will not be included in the cost estimate since this data format is currently under development and is not mature enough to be considered as a delivery option at this time. Product data files and text data files are described in various subsections of 4.1, and a discussion of "Intelligent" data is provided in Appendix B. These data deliverables provide all the data uses described in MIL-HDBK-59 including view, archive, comment, annotate, extract, process, and transform. Suggested delivery media options include: (1) Optical disk, (2) magnetic disk, or (3) 9-track magnetic tape, all in accordance with MIL-STD-1840. Paper documentation may be requested in addition to the digital data deliverables but only for verification of the digital data.

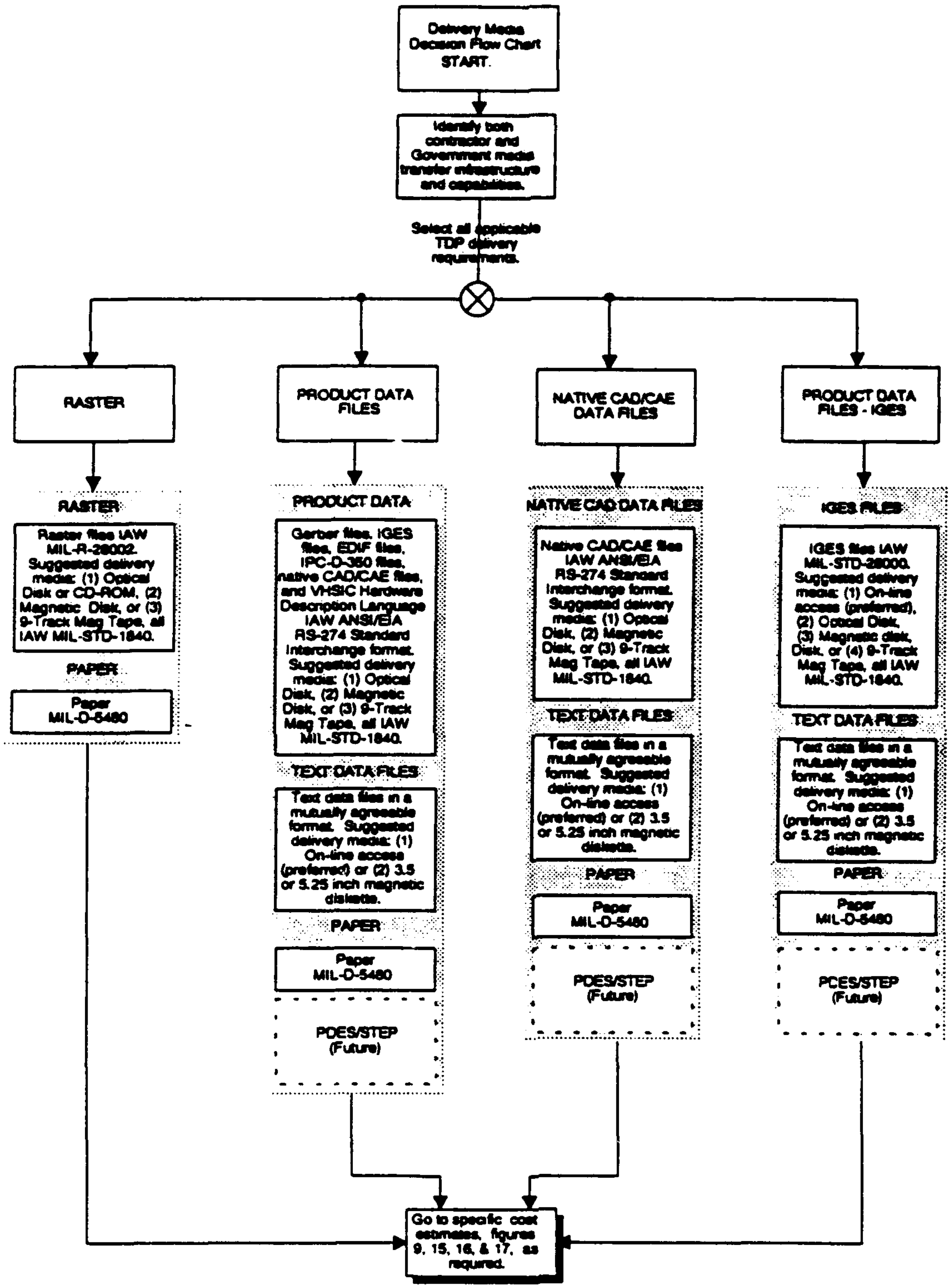


FIGURE 8. Select Delivery Media Decision Flow Chart

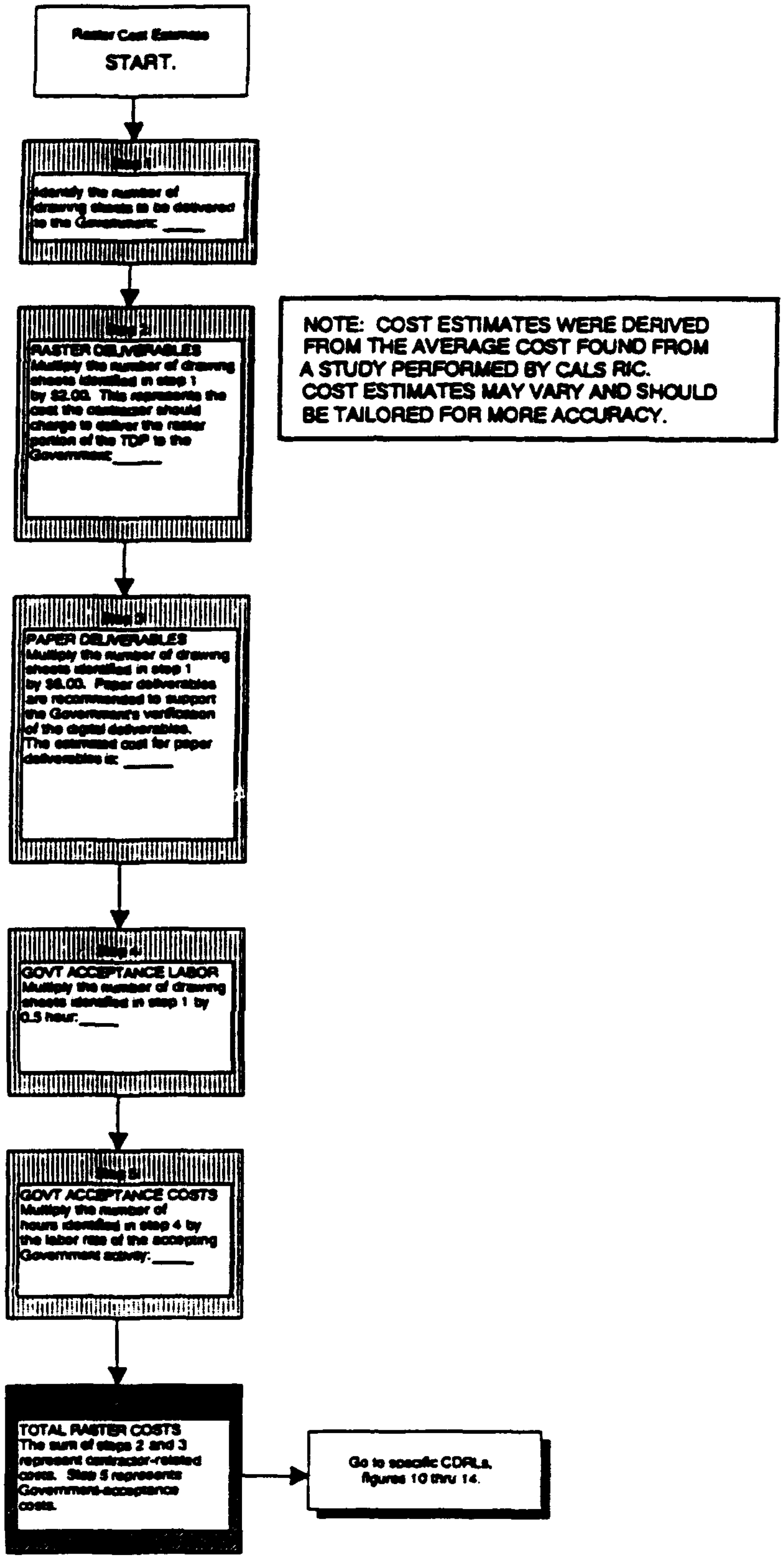


FIGURE 9. Cost Estimate - Raster

CONTRACT DATA REQUIREMENTS LIST
(Data Item)

Form Approved
OMB No. 0704-0188

[illegible]

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY TDP X TM - OTHER

D. SYSTEM/ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE
	PRODUCT DRAWINGS AND ASSOCIATED LISTS	XXX WEAPONS PLATFORM

4. AUTHORITY (Data Acquisition Document No.)	5. CONTRACT REFERENCE	6. REQUIRING OFFICE
SEE BLK 16		

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION
DD	SEE BLK 16		
8. APP CODE		**11. AS OF DATE**	**13. DATE OF SUBSEQUENT SUBMISSION**
A			

14. DISTRIBUTION			
a. ADDRESSEE	b. COPIES		
	Draft	Final	
		Reg	Repro
SEE BLK 16			
15. TOTAL			

16. REMARKS

BLK 4: DI-DRPR-81000, DD FORM 2554-1 WITH ATTACHMENT. IF ORDERED, REPRO COPIES SHALL BE IAW MIL-D-5480, (ADD TYPE, CLASS, & KIND).

BLK 8: APPROVAL SHALL BE BASED ON COMPLIANCE WITH REQUIREMENT DOCUMENTS CITED IN BLK 4. THE TIME REQUIRE FOR GOVERNMENT APPROVAL WILL NOT EXCEED ____ DAYS AND TURNAROUND TIME FOR CONTRACTOR TO RESUBMIT DATA TO GOVERNMENT SHALL NOT EXCEED ____ DAYS. (ADD TIME REQUIRED FOR GOVERNMENT APPROVAL AND TURNAROUND TIME FOR CONTRACTOR TO RESUBMIT DATA TO GOVERNMENT.)

BLK 9: TECHNICAL DATA SHALL BE MARKED (DISTRIBUTION STATEMENT AND EXPORT CONTROL WARNING NOTICE) IAW MIL-STD-1806, MIL-STD-100, AND CDRL SUPPLEMENT ATTACHMENT. VENDOR ITEM DRAWINGS SHALL BE DISTRIBUTION STATEMENT A, PROVIDED WHERE-USED-ON BLOCK IS BLANK; OTHERWISE, ALL REMAINING DRAWINGS SHALL BE DISTRIBUTION STATEMENT ____ (SPECIFY LETTER). SEE CDRL SUPPLEMENT ATTACHMENT.

BLK 14: DISTRIBUTION SHALL BE IAW CDRL SUPPLEMENT ATTACHMENT.

THIS IS A SAMPLE CDRL. INFORMATION SHOULD BE TAILORED TO REFLECT PROGRAM REQUIREMENTS

NOTES: (1) COMPLETE THIS FORM IAW "INSTRUCTIONS FOR COMPLETING DD FORM 1423" AND DOD 5010.12-M (CHAPTER 3). INCLUDE REFERENCE TO DD FORM 2554-1, CDRL SUPPLEMENT ATTACHMENT(S), AND ATTACHMENT(S) AS NEEDED. (2) COMPLETE DD FORM 2554-1 IAW MIL-T-31000 (ENTER DIGITAL DATA SPECIFICATION, EXCHANGE MEDIA, ETC., IN BLOCK 1.C OR VIA CONTRACT ATTACHMENT (3) COMPLETE ATTACHMENT(S) FOR DD FORM 2554-1 AND CDRL SUPPLEMENT.

G. PREPARED BY	H. DATE	I. APPROVED BY	J. DATE

DD FORM 1423-1, JUN 90

FIGURE 10. Sample CDRL For TDP Elements

TDP OPTION SELECTION WORKSHEET
PRODUCT DRAWINGS AND ASSOCIATED LISTS

A. CONTRACT NO.	B. EXHIBIT/ATTACHMET NO.	C. CLIN.	D. CDRL DATA ITEM NO.

1. DELIVERABLE PRODUCT (X and complete as applicable)

	a. ORIGINALS (Drawing masters) (Indentify specification, type, grade and class, etc.)
	b. REPRODUCTIONS (Identify specification, type, grade and class, etc., and quantity of each)
X	c. DIGITAL DATA (Identify specification, exchange media, etc.) See contract attachment for DD Form 2554-1 Digital Data Deliverables

2. CAGE CODE AND DOCUMENT NUMBERS (X one)

	a. CONTRACTOR
	b. GOVERNMENT (Complete (1) and (2) or (3))

(1) Use CAGE Code	(2) Use Document Numbers	(3) To Be Assigned By:

3. DRAWING FORMATS AND DRAWING FORMS (X one and complete as applicable)

	a. CONTRACTOR FORMATS. Forms to be supplied by contractor.
	b. GOVERNMENT FORMATS. Forms to be supplied by contractor. Samples supplied by (Specify)
	c. GOVERNMENT FORMATS. Forms to be supplied as Government Furnished Material by (Specify)

4. TYPES AND QUANTITY OF DRAWINGS SELECTION (X one)

	a. CONTRACTOR SELECTS		b. GOVERNMENT SELECTS (Specify in Item 9)

5. ASSOCIATED LISTS (X and complete as applicable)

	a. PARTS LISTS (X one)		(1) Integral		(2) Separate		(3) Contractors Option
	b. DATA LISTS (X one)		(1) Not Required		(2) Required (Specify levels of assembly)		
	c. INDEX LISTS (X one)		(1) Not Required		(2) Required (specify levels of assembly)		

6. DETAILS (X one)

	a. MULTIDETAIL DRAWINGS PERMITTED		b. MONODETAIL DRAWINGS MANDATORY

7. QUALITY ASSURANCE PROVISIONS (X one)

	a. NOT REQUIRED. MIL-T-31000, para 3.8 does not apply.
	b. REQUIRED. MIL-T-31000, para 3.8 applies. Quality assurance requirements shall be documented as QAPs in accordance with MIL-T-31000, Appendix B. (X one)

	(1) DARCOM Form 2484-R Required		(2) DARCOM Form 2484-R Not Required

8. VENDOR SUBSTANTIATION DATA (X one)

	a. NOT REQUIRED		b. REQUIRED

9. OTHER TAILORING (Attach additional sheets as necessary)

This is a sample DD Form 2554-1 digital data denoted. Information should be tailored to reflect program requirements.

DD Form 2554-1, DEC 89 0102-LF-009-3200 U.S. GOVERNMENT PRINTING OFFICE 1990 - 704-010

FIGURE 11. Sample DD form 2554-1 Digital Data Denoted

Contract # ____
Page 1 of ____

ATTACHMENT XX

DD FORM 2554-1, BLK 1.c, DIGITAL DATA DELIVERABLES

2554-1, BLK 1.c	Order ( )	PRODUCT DELIVERABLES IN DIGITAL FORMAT
(1)	( )	DRAWING MASTER RASTER DATA
(2)	( )	DRAWING TRIAL RASTER DATA
(3)	( )	DRAWING MASTER PRODUCT DATA
(4)	( )	DRAWING TRIAL PRODUCT DATA
(5)	( )	DRAWING MASTER NATIVE CAD/CAE DATA
(6)	( )	DRAWING TRIAL NATIVE CAD/CAE DATA
(7)	( )	DRAWING MASTER IGES CAD/CAE DATA
(8)	( )	DRAWING TRIAL IGES CAD/CAE DATA
(9)	( )	OTHER - SEE NOTE BELOW
(10)	( )	TBD
(11)	( )	TBD
(12)	( )	TBD

REQUIREMENTS FOR PRODUCT DELIVERABLES

(1) Drawing Master Raster Data. Drawing master raster graphic tape shall be IAW MIL-R-28002, MIL-STD-1840 and the following requirements. Data shall be on a 9-track magnetic tape. Raster graphics shall be type 1 untiled raster data, 512 X 512 in size. Each delivered 9-track tape shall include a ANSI label. Raster image density shall be 200 PELS/inch. The minimum number of PELS per line and minimum number of scanlines shall be IAW MIL-R-28002. Raster image orientation shall be PEL path of 90 line progression of 270. Acceptance of this data item shall be based upon: self merit/content; prior acceptance and validation of drawing trial raster data, BLK 1.c(2), if ordered; and visual comparative agreement with drawing originals or reproductions, if ordered.

(2) Drawing Trial Raster Data. Requirements shall be the same as those for drawing master raster data, BLKl 1.c(1), SANS prior acceptance of self.

(3) Drawing Master Product Data. Drawing master product data shall be IAW VHDL ANSI/IEEE 1076, EDIF EIA 548, and IPC-D-350 and the following requirements. Data shall be on MIL-STD-1840 magnetic tape format optical disk, CD-ROM, or magnetic disk with a mutually agreed upon format. Data shall be organized as one drawing per file with multiple sheets permitted. E[illegible] [illegible]ted or unspecified by the appropriate standards or specifications (VDHL, IPC, etc.) shall [illegible] data transfer integrity of the product information delivered under the contract. Format version "(X)" shall be used. Acceptance of this data item shall be based upon: self merit/content; prior acceptance and validation of drawing trial product data, BLK 1.c(4), if ordered; and visual comparative agreement with drawing originals or reproductions, if ordered. Validation here means determination of acceptable transfer and translation of data from the contractor's CAD/CAE system to the _____(add applicable interfacing system).

NOTE: THIS IS A SAMPLE ATTACHMENT. INFORMATION SHOULD BE TAILORED TO REFLECT PROGRAM REQUIREMENTS. SEE TECHNICAL MANUALS SECTION OF THE DESKTOP GUIDE FOR "COMPOUND DOCUMENTS" (SPECIFICATIONS, SOFTWARE, DOCUMENTATION, LISTS, ETC.).

FIGURE 12. Sample Contract Attachment On "DD Form 2554-1, BLK 1.c, Digital Data Deliverables"

ATTACHMENT XX (CONT.)

REQUIREMENTS FOR PRODUCT DELIVERABLES (CONT.)

(4) Drawing Trial Product Data. Requirements shall be same as those for drawing master product data, BLK 1.c(3), SANS prior acceptance of self.

(5) Drawing Master Native CAD/CAE Data. Drawing master native CAD/CAE data shall be as follows. The data file format shall be delivered on a 9-track QIC tape, CD-ROM or magnetic disk, compatible with ____ (insert vendor product name). CAD/CAE system media shall be clearly labeled to describe the media format method, content, and media density. Data shall be organized as one drawing per file with multiple sheets permitted. Data format shall be compatible with ____(insert vendor application package name, version number) format, using the native binary format supported by the ____ (insert vendor product name) CAD system. All information necessary to open and manipulate the data files, including: libraries, logical name definitions, and other supporting files shall be delivered with drawing files. Non-vendor-supported "Utilities" (i.e., software product) shall not affect the data transfer integrity of the product information delivered under the contract. Acceptance of this data item shall be based upon: self merit/content; prior acceptance and validation of drawing trial native CAD/CAE data, BLK 1.c(6), if ordered; and visual comparative agreement with drawing originals or reproductions, if ordered. Validation here means determination of acceptable transfer and translation of data from the contractor's CAD/CAE system to the ____(add applicable interfacing system).

(6) Drawing Trial Native CAD/CAE Data. Requirements shall be the same as those for drawing master native CAD/CAE data, BLK 1.c(5), SANS prior acceptance of self.

(7) Drawing Master IGES CAD/CAE Data. Drawing master IGES CAD/CAE data shall be as follows. Data shall be delivered on a 9-track tape, QIC tape, or magnetic disk. Data shall be organized as one drawing per file with multiple sheets permitted. MIL-D-28000 defined entities are mandatory. Entities not fully supported or supported by a subset of MIL-D-28000 to best match the contractor's CAD features, shall be identified by the contractor. Unsupported or unspecified "volunteer" entities shall not affect the data transfer integrity of the product information delivered under the contract. Data product files shall be written in ASCII form. Acceptance of this data item shall be based upon: self merit/content; prior acceptance and validation of drawing trial IGES CAD/CAE data, BLK 1.c(8), if ordered; and visual comparative agreement with drawing originals or reproductions, if ordered. Validation here means determination of acceptable transfer and translation of data from the contractor's CAD/CAE system to the ____(add applicable interfacing system).

(8) Drawing Trial IGES CAD/CAE Data. Requirements shall be same as those for drawing master IGES CAD/CAE data, BLK 1.c(7), SANS prior acceptance of self.

(9) Other

(10) TBD

(11) TBD

(12) TBD

THIS IS A SAMPLE ATTACHMENT. INFORMATION SHOULD BE TAILORED TO REFLECT PROGRAM REQUIREMENTS.

FIGURE 12 (cont.). Sample Contract Attachment On "DD Form 2554-1, BLK 1.c, Digital Data Deliverables"

Contract # ____

Page 1 of 2

ATTACHMENT XX

DISTRIBUTION STATEMENT ON TECHNICAL DOCUMENTS

The purpose of this contract attachment is to establish procedures for marking technical documents, including production, engineering , and logistics information, to denote the extent to which they are available for distribution release, and dissemination without additional approvals or authorizations.

Distribution covers all engineering drawings, standards, specifications, technical manuals, blueprints, drawings, plans, instructions, computer software and documentation, and other technical information that can be used or be adapted for use to design, engineer, produce manufacture, operate, repair, overhaul, or reproduce any military or space equipment or technology concerning such equipment.

The distribution statement markings shall be mandatory for all technical documents, including such informal documents as working papers, memoranda, and preliminary reports if those documents are not already in the public domain and if they are likely to be disseminated outside of the Department of Defense.

The distribution statement shall be displayed conspicuously on technical documents so as to be recognized readily be recipients.

The following shall apply for standard written or printed material:

1. The distribution statement shall appear on each front cover, title page and DD Form 1473, "Report Documentation Page."

2. When practicable, the abstract of the document, the DD Form 1473 and bibliographic citations shall be written in such a way that the information will not be subject to distribution statement B, D, E, or F.

If the technical information is not prepared in the form of an ordinary document and does not have a cover or title page (such as forms and charts), the applicable distribution statement shall be stamped, printed, written, or affixed by other means in a conspicuous position.

A distribution statement marking is distinct from and in addition to a security classification marking.

THIS IS A SAMPLE ATTACHMENT. INFORMATION SHOULD BE TAILORED TO REFLECT PROGRAM REQUIREMENTS.

FIGURE 13. Sample Contract Attachment for Distribution Statements

Contract #_____
Page 2 of 2

ATTACHMENT XX

DISTRIBUTION STATEMENT DEFINITIONS

Distribution Statement A. Approved for public release; distribution is unlimited.

Distribution Statement B. Distribution authorized to US Government agencies only; Contractor Performance Evaluation and/or Administrative or Operational Use; 13 November 1986. Other requests for this document shall be referred to the Naval Air Systems Command (PMA-242).

Distribution Statement D. Distribution authorized to the DoD and US DoD contractors only; Critical Technology; 13 November 1986. Other requests shall be referred to the Naval Air Systems Command (PMA-242).

Distribution Statement E. Distribution authorized to DoD Components only; Critical Technology and Software Documentation; 13 November 1986. Other requests for this document shall be referred to the Naval Air Systems Command (PMA-242).

Distribution Statement F. Further distribution only as directed by Naval Air Systems Command (PMA-242) or higher DoD authority; 13 November 1986.

All technical documents that are determined to contain export-controlled technical data shall be marked "WARNING-This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C. SEC 2751, et seq.) or the Export Administration Act of 1979, as amended, Title 50, U.S.C., App 2401 et seq. Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of DoD Directive 5230.25."

For classified documents, follow the procedures in DoD 5200.00-M, Industrial Security Manual, Chapter 5, Section 5-708 or DoD 5200.1-R, Information Security Program Regulation, Chapter IX.

THIS IS A SAMPLE ATTACHMENT. INFORMATION SHOULD BE TAILORED TO REFLECT PROGRAM REQUIREMENTS.

FIGURE 13 (cont.). Sample Contract Attachment for Distribution Statements

ATTACHMENT XX

DD FORM 1423-1, BLK 14, "DISTRIBUTION"

CONTRACT #
PAGE 1 OF X

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY TDP ______ TM ______ OTHER ______
D. SYSTEM/ITEM	E. CONTRACT / PR NO.	F. CONTRACTOR

14. DISTRIBUTION														
a. ADDRESSEE	b. COPIES													
	Draft	Final		DIGITAL (DD FORM 2884-1, BLK 1.C & BLK 8)										
		Reg	Repro	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	( )	( )	( )
15. TOTAL ⟶														

THIS IS A SAMPLE CDRL SUPPLEMENT ATTACHMENT.
TAILOR INFORMATION CONTENT TO REFLECT PROGRAM REQUIREMENTS

DIGITAL LEGEND:
V = VIEW ONLY E = EXTRACT/PROCESS/TRANSFORM U = UPDATE/MAINTAIN C = COMMENT/ANNOTATE A = APPROVE
E.G.: V-4 = VIEW ONLY, FOUR TIMES

FIGURE 14. Sample Attachment for DD Form 1423-1, Blk 14, "Distribution"

4.4.9.1 Cost.

Once product data files has been selected as the data delivery format, the cost of acquiring this data can be calculated. A chart (see figure 15) has been developed to assist the Acquisition Manager in estimating this cost. This 15-step process includes cost estimates for a variety of data delivery options. The Acquisition Manager should skip over any of the data delivery options not required by the defense system program. If paper deliverables are not required for verification, as in the early stages of the defense system's life cycle, they may be left out of the cost estimate by skipping step 8.

Note: This chart will provide an approximation of costs associated with these data deliverables. Specific program requirements, especially labor rates, may vary from those presented here and may be substituted for the rates shown.

4.4.9.2 CDRLs

To invoke these data deliverable options, specific CDRLs (see figures 10 through 14) have been developed to be used as examples. The information contained in these contract vehicles should be tailored to meet the requirements of the specific defense system program. The CDRL(s) must include language that specifies exactly how data will be delivered (including media, format, and content) under the contract. CALS standards should be invoked whenever possible.

4.4.10 Native CAD/CAE Data File Delivery Option

CAD/CAE data files in native format (see figure 8) consist of a variety of data delivery options including native CAD data files, text data files, and PDES. PDES, which has been included in figure 8, will not be included in the cost estimate since this data is currently under development and is not "mature" enough to be considered as a delivery option at this time. CAD data files and text data files are described in 4.1.1.2.1 and 4.1.1.2.2 respectively, and a discussion of intelligent data is provided in Appendix B. These data deliverables provide all the data uses described in MIL-HDBK-59 including view, archive, comment/annotate, update/maintain, and extract/process/transform. Suggested delivery media options include: (1) Optical disk, (2) magnetic disk, or (3) 9-track magnetic tape, all in accordance with MIL-STD-1840. Paper documentation may be requested in addition to the digital data deliverables but only for verification of the digital data.

4.4.10.1 Cost

Once CAD/CAE data files in native format has been selected as the data delivery format, the cost of acquiring this data can be calculated. A chart (see figure 16) has been developed to assist the Acquisition Manager in estimating this cost. This seven-step process includes cost estimates for both CAD/CAE data files and paper data delivery options. The Acquisition Manager should skip over any of the data delivery options not required by the defense system program. If paper deliverables are not required for verification, as in the early stages of the defense system's life cycle, they may be left out of the cost estimate by skipping step 4.

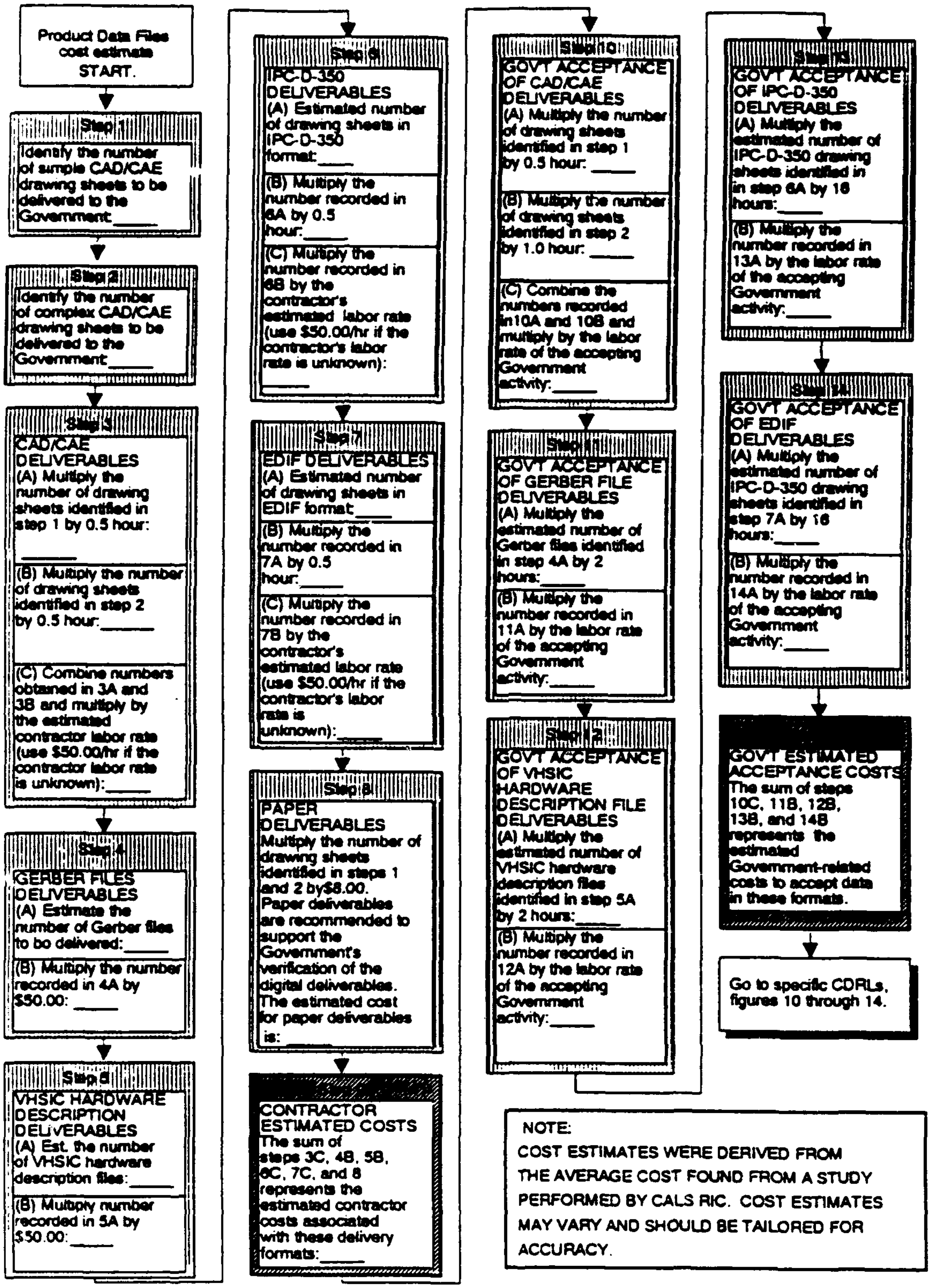


FIGURE 15. Cost Estimate - Product Data Files

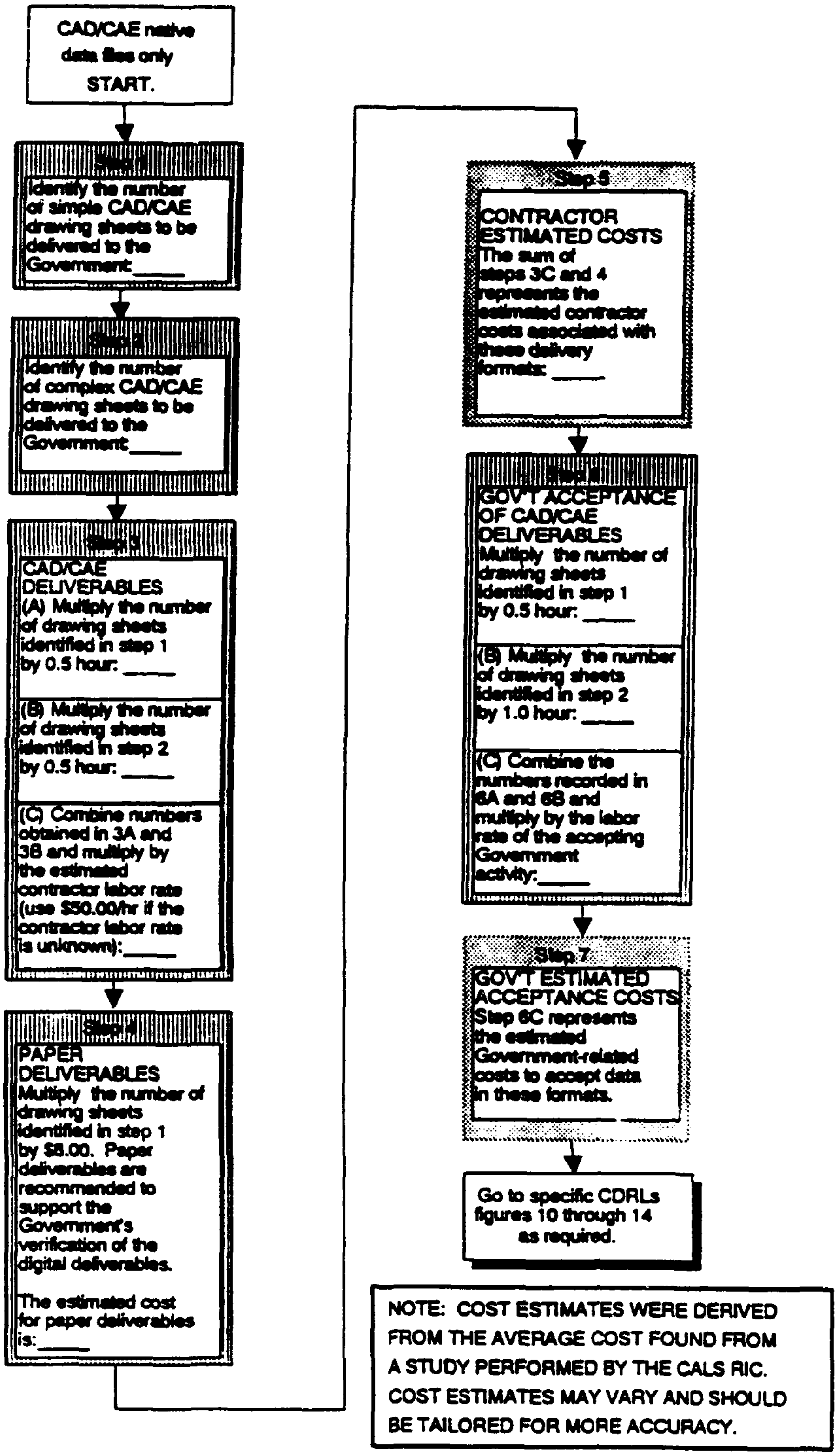


FIGURE 16. Cost Estimate - Native CAD/CAE Data Files

Note: This chart will provide an approximation of costs associated with these data deliverables. Specific program requirements, especially labor rates, may vary from those presented here and may be substituted for the rates shown.

4.4.10.2 CDRLs

To invoke these deliverable options, specific CDRLs (see figures 10 through 14) have been developed to be used as examples. The information contained in these contract vehicles should be tailored to meet the requirements of the specific defense system program. The CDRL(s) must include language that specifies <u>exactly</u> how data will be delivered (including media, format, and content) under the contract. CALS standards should be invoked whenever possible.

4.4.11 Product Data File Delivery Option (IGES Format)

Product data files in IGES format (see figure 8) consist of a vanety of data delivery options including IGES files, text data files, and PDES. PDES, which is included in figure 8, will not be included in the cost estimate since this data is currently under development and is not "mature" enough to be considered as a delivery option at this time. IGES files are included in the discussion of CAD data files in 4.1.1.2.1, and text data files are described in 4.1.1.2.2. A discussion of "Intelligent" data is provided in Appendix B. These data deliverables provide all the data uses described in MIL-HDBK-59 including view, archive, comment/annotate, update/maintain, and extract/process/transform. Suggested delivery media options include: (1) Optical disk, (2) magnetic disk, or (3) 9-track magnetic tape, all in accordance with MIL-STD-1840. Paper documentation may be requested in addition to the digital data deliverables but only for verification of the digital data.

4.4.11.1 Cost

Once product data files in IGES format has been selected as the data delivery format, the cost of acquiring this data can be calculated. A chart (see figure 17) has been developed to assist the Acquisition Manager in estimating this cost. This seven-step process includes cost estimates for both IGES files and paper data delivery options. The Acquisition Manager should skip over any of the data delivery options not required by the defense system program. If paper deliverables are not required for verification as in the early stages of the defense system's life cycle, they may be left out of the cost estimate by skipping step 4.

Note: This chart will provide an approximation of costs associated with these data deliverables. Specific program requirements, especially labor rates, may vary from those presented here and may be substituted for the rates shown.

4.4.11.2 CDRLs

To invoke this data deliverable option, specific CDRLs (see figures 10 through 14) have been developed to be used as examples. The information contained in the following contract vehicles should be tailored to meet the requirements of the specific defense system program. The CDRL(s) must include language that specifies <u>exactly</u> how data will be delivered (including media, format, and content) under the contract. CALS standards should be invoked whenever possible.

4.4.12 Delivery Option Advantages

Delivery of the TDP as paper, raster, vector, or processable data file has both advantages and disadvantages. Table 1 lists some of these advantages and disadvantages.

TABLE 1. Advantages and Disadvantages of Deliverable Options

Type	Paper	Raster	Vector	Processable Data Files
ADVANTAGES	1. Already a deliverable form 2. Can be copied and distributed easily	1. Importable into documents 2. Already a deliverable form 3. Electronic indexing/filing/ archiving 4. Nearly exact fidelity for illustrations providing format is standard (tiled raster format only, MIL-R-28002) 5. Files can be compressed to reduce size (tiled raster format only, MIL-R-28002)	1. Easily edited/maintained/ updated 2. Electronic indexing/filing/ archiving 3. Small file sizes compared to raster equivalents 4. File information compatibility between editing and sending and receiving systems 5. Files contain some intelligent data	1. Easily edited/maintained/ updated 2. Electronic indexing/filing/ archiving 3. Already a deliverable form 4. Files accept generic text and raster data from other sources
DISADVANTAGES	1. Cannot be edited or changed 2. Not importable (must be scanned to digitize) 3. Bulky filing system 4. Originals can be easily lost or destroyed 5. Originals deteriorate over time	1. Editing is extremely tedious (must be converted to a vector form to edit easily 2. Relatively large file sizes 3. Induced errors from incompatibilities of hardware even when using an agreed to standard 4. Raster quality dependent on original and chosen pels/inch standard (MIL-R-28002) 5. Raster quality also dependent on accuracy of equipment and method used to scan original image (MIL-R-28002)	1. Not directly importable into documents, must be converted to a raster format	1. Government standards not fully developed 2. Drawing data limited to imported raster images

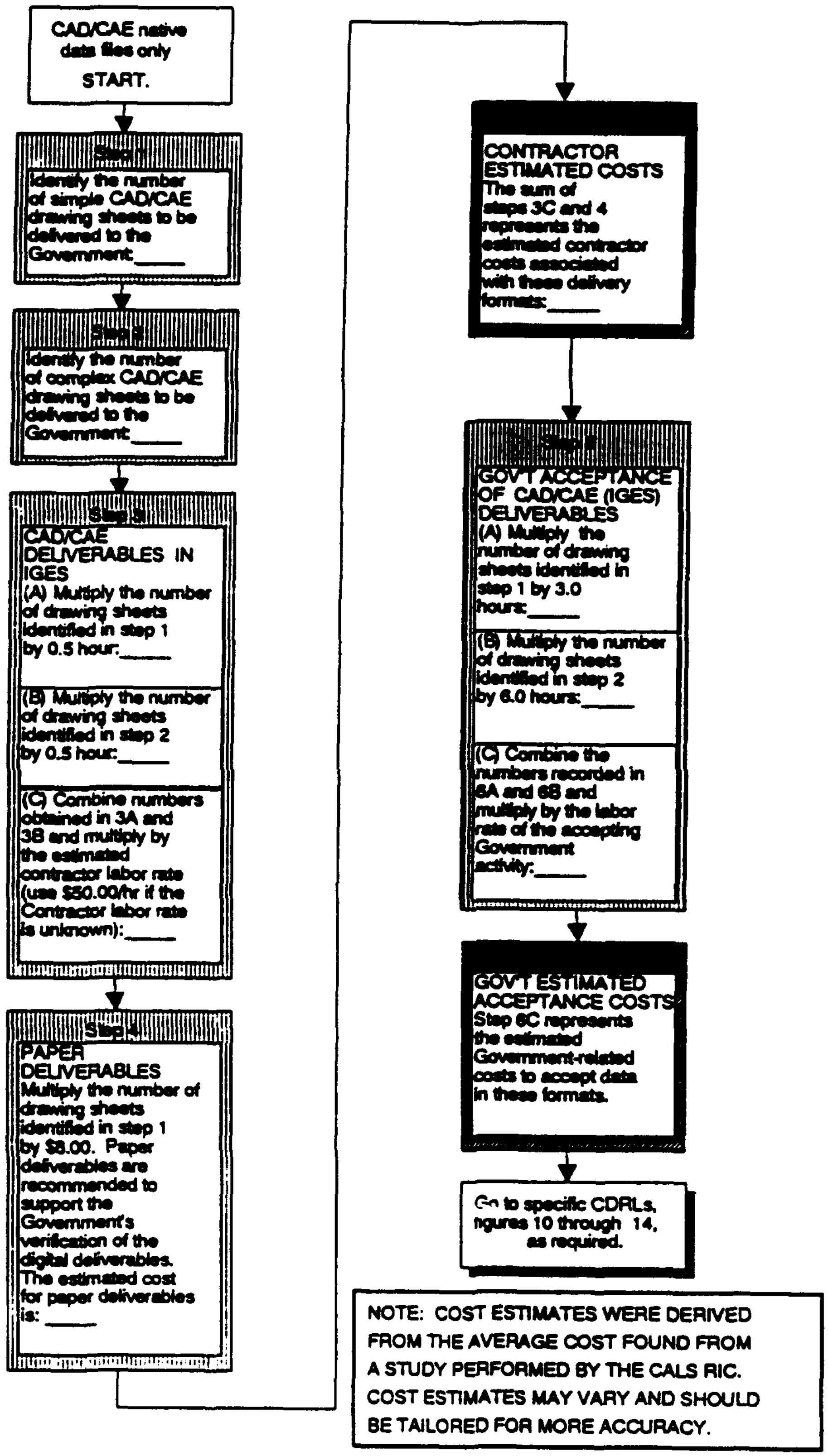


FIGURE 17. Cost Estimate - Product Data Files - IGES

4.5 Contractor Validation

The contractor should be required to validate that the TDP and associated elements conform to the contractual requirements. In those instances where materiel has been developed or produced, the contractor shall validate that the TDP and associated elements accurately depict the materiel developed or produced under the contract. Use of the TDP in producing, inspecting, and testing satisfactory materiel is considered acceptable evidence that the validation requirement has been met. When specified in the contract or purchase order, the contractor's validation shall be documented in a TDP validation report.

4.5.1 Validation by Contractor Physical Configuration Audit (PCA) or Verification Reviews

The Government may require the contractor to validate the TDP through PCAs, configuration item verification reviews (CIVRs), or by other methods through specific work tasks in the statement of work of the contract or purchase order. Unless such tasks are included in the contract or purchase order, the method of validation shall remain the contractor's option.

4.5.2 TDP Validation Report

A TDP validation report is used by the Government to review the procedures and evaluate the results of the contractor's validation of the TDP as conforming to the data requirements in the contract or purchase order.

4.6 Government Verification

The acceptance of CALS digital data products, either delivered on physical media or by CITIS, is different in several ways from the acceptance of comparable paper data products. The following paragraphs provide details on the acceptance of digital data products and information services.

4.6.1 Digital Data Product Acceptance

The unique aspect of CALS digital data deliverables is that they will be subject to inspec[illegible]on and ac[illegible] on several levels. The lowest level of acceptance is the dat[illegible] conte[illegible] [illegible]at. The acceptance process at this level is identical to acceptance of the data product provided on paper. This level of acceptance will be accomplished by viewing the data either through use of a computer video screen or by viewing a paper printout of the data product.

The next level of acceptance is adherence to the specified CALS data exchange format. This will usually be compliant with the CALS standardization documents or other national or international data exchange standards. This level of acceptance may be aided by automated tools obtained, if available, from the CALS Test Network (CTN) or each service-component CALS office.

The next level of acceptance is applied to the MIL-STD-1840 digital data format if it has been specified. Again, automated tools may be used to verify compliance. Other formatting requirements that may be subject to inspection and acceptance include the X12 EDI format if it has been specified (see 3.7.1).

Finally, the physical media may have acceptance criteria to be applied. This level of acceptance will not be used if data has been formally delivered by the CITIS. The means of inspection to be used should be provided to the contractor as soon as these means have been determined. Any or all levels of acceptance may be performed at the contractor's facility or at a Government facility, as required. In addition to digital data acceptance, CITIS requires that additional acceptance requirements be applied.

4.6.2 CITIS Acceptance

Acceptance of the service and the CITIS Contract Line Item Number (CLIN), if utilized, is a verification that the contractor has provided the service as specified. The CITIS functional requirements are defined by MIL-STD-CITIS draft (MIL-STD-974) and the particular statement of work. A checklist of CITIS functional requirements may be prepared to assist in tracking contractor compliance. These functional requirements may include service availability, maintenance response, provision for core information functions, provision for value-added information functions, and the like.

Assurances of adequate acceptance testing for CITIS should be obtained via contractor demonstration of the service. The test should include demonstration of functional capabilities and verification that the CITIS will handle the data required without alteration of the data product. Such a test is not required for each delivery but may be rerun if major maintenance has been accomplished or if the sending or receiving systems have been changed enough to warrant an additional test. If specific test data are deemed necessary for adequate testing of a CITIS, that test data should be provided and results reviewed on-site at a customer facility. On-line access service should be accepted when it is demonstrated that a person with proper authorization can perform the contractually required core and value-added functions from a terminal or workstation at the customer's facility or as otherwise agreed.

Electronic data transfer service acceptance should occur when a single instance of transfer of the specific deliverable type can be achieved including successful download of data into the customer's system when contractually required. This data may be real product data or test data, as appropriate.

4.6.3 CALSIP Acceptance

The original contracts baseline requirements for CALS-compliant product(s) are subject to change and redefinition, by mutual agreement, throughout the duration of the contract. The Government verifies and controls, in part, the adequacy of the CALS product change and redefinition process via the approval of the original and revision(s) of the CALSIP along with the final acceptance of the CALSIP at contract completion.

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

NAVY/MARINE CORPS MANAGER'S DESKTOP GUIDE FOR CALS IMPLEMENTATION

SECOND EDITION
30 JUNE 1993

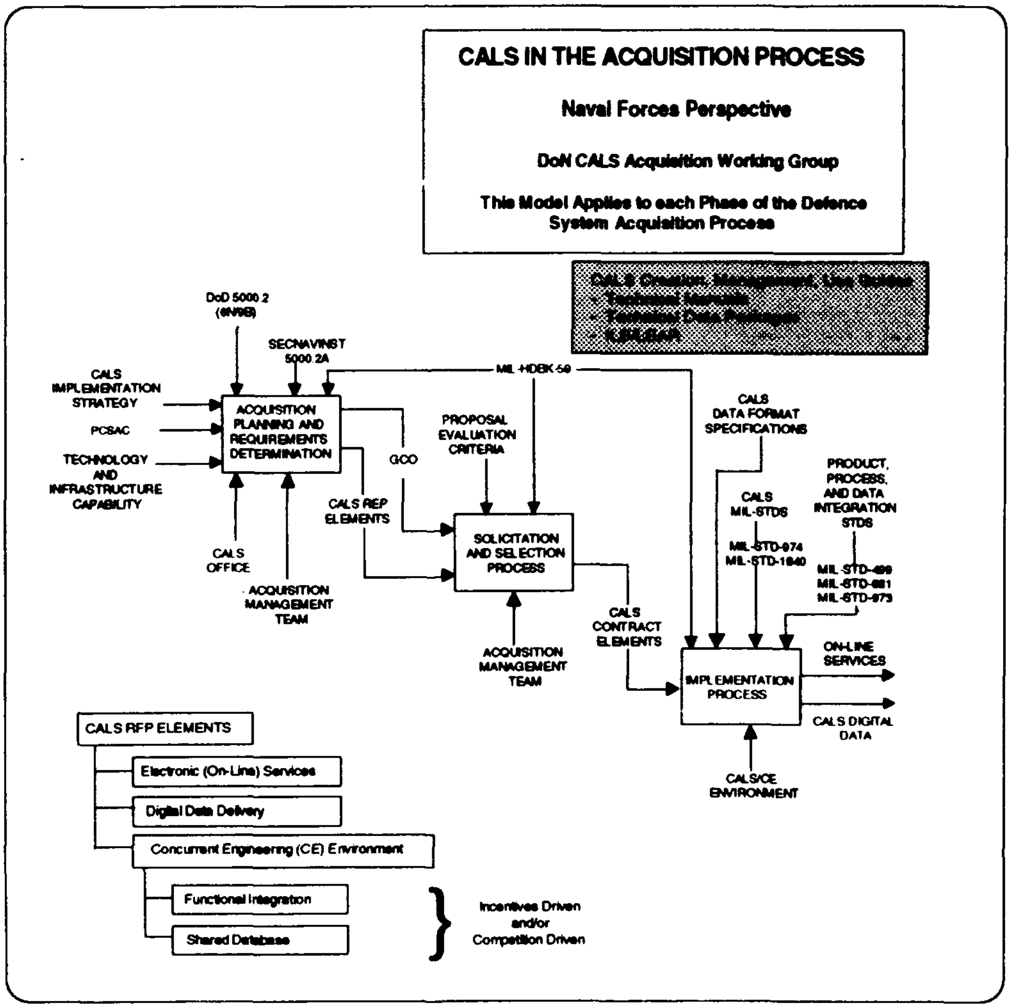
GUIDE CONTENTS

CALS

COMPUTER-AIDED ACQUISITION
AND LOGISTIC SUPPORT

SECTION 7

Applying CALS To The Creation, Management, And Use Of Technical Manuals



APPLYING CALS TO THE CREATION, MANAGEMENT, AND USE OF TECHNICAL MANUALS

SECOND EDITION

30 June 1993

Prepared by:
CALS Resource and Implementation Cooperative

Prepared for:
Navy CALS Acquisition/ Implementation Group

FOREWORD

Purpose

The Navy Computer-aided Acquisition and Logistic Support (CALS) Acquisition/Implementation Sub-Group has charged the CALS Resource and Implementation Cooperative (RIC) with developing acquisition guidance for each of the three process architectures defined in the Department of the Navy CALS Architecture/Implementation Plan. This document is the result of an exhaustive search and distillation of information pertinent to applying CALS to the creation, management, and use of Technical Manuals (TMs). The intended audience of this document is the Acquisition management team that may consist of Navy/Marine Corps Acquisition Managers, TM Managers, project engineers, and project logisticians. This document lends itself to incorporation into specific Naval Forces System Command and Marine Corps program manager guides for applying CALS to defense system procurements.

Scope

The three process architectures described in the Navy CALS Architecture/Implementation Plan are:

- Engineering Drawings
- Technical Manuals
- Logistic Support Analysis Record (LSAR).

This revision has been expanded to include:

- Process Flow
- Proposal Evaluation Criteria
- Discussion on Contractor Integrated Technical Information Service (CITIS)
- Decision Oriented Templates.

Overview

Section 3.0, *General Considerations*, provides topics of consideration that must be addressed by the acquisition management team pertaining to the application of CALS initiatives to TMs. This section covers the following considerations:

- TM Decision and Responsibility
- Identify/Establish the TM Requirement
- Identify TM User's Infrastructure
- TMs in a CALS Environment
- Life Cycle Considerations
- Contract Language.

Section 4.0, *Specific Considerations*, uses these topics as a basis to discuss specific transfer media and digital data format considerations through decision templates that will assist the acquisition management team in determining which of these will satisfy the defense system program's TM requirements. Sample contract language to help develop CALS-related contract documents and a discussion of validation and verification issues are also included.

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APPENDIXES

Appendixes A, B, and C as referenced in this document are in the back of the Desktop Guide.

FIGURES

TABLES

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1.0 INTRODUCTION

Computer-aided Acquisition and Logistic Support (CALS) is a Department of Defense (DoD) and industry strategy intended to enable more effective generation, exchange, management, and use of digital data supporting defense systems and equipment. Technical Manuals (TMs) are publications that contain instructions for the installation, operation, maintenance, and support of defense systems, defense system components, and support equipment. Using CALS standards to define the digital environment for the creation, management, and use of TMs will provide the method for transitioning from paper-intensive defense system acquisition and support processes to automated and integrated digital processes.

It should be noted that the application of digital technologies to Navy processes should be seen as a way to improve and streamline these processes by providing better methods of creating, managing, and using data, not as a method of replacing existing business practices.

1.1 Scope

Considerations that must be addressed when the acquisition management team is acquiring TMs in digital format include who will use the data and what infrastructure will they need to use it. Three levels of activity (see figure 1) exist, and all must have the ability to access and apply the digital data.

The first activity is the acquisition program office itself. It will be impossible possible to manage a program adequately if the TM agent does not have the capability to review and comment on the TM that is being delivered. The acquisition management team must insure that appropriate hardware and software are in place to review the data before digital data is ordered and delivered.

The second level of activity that must be considered is the specific Navy infrastructure program that will manage and store the digital data once it's created. The data delivered must be compatible with the existing Navy infrastructure in place or being developed. If changes to the Navy infrastructure are required, they must be fully justified and coordinated with personnel responsible for the configuration control of the Navy infrastructure system.

The final level of activity that must be considered is the end user. It does the end user no good to generate and make available digital data that they are incapable of using. The acquisition management team cannot assume the systems exist and will be used. The specific environment must be determined. Questions must be asked. What systems are available in the field? For a specific user, what data media and formats are compatible with what they already have or are planning to get? How will they acquire the new equipment and software they need if existing systems are inadequate? How will these new systems be supported? Who will pay for these new systems? The answers to these and similar questions will provide a comprehensive plan for implementing and using the digital data that is acquired. The answers depend on the specific users in the specific program.

It is recognized that each defense system program is unique with individual constraints and access to a distinct set of infrastructure systems. This document is intended to

provide the acquisition management team with an overview of Navy business practices for the creation, management, and use of TMs in a CALS environment yet maintain flexibility for innovative approaches. Specific implementation of this process may be further tailored with guidance set forth by each Naval Forces System Command.

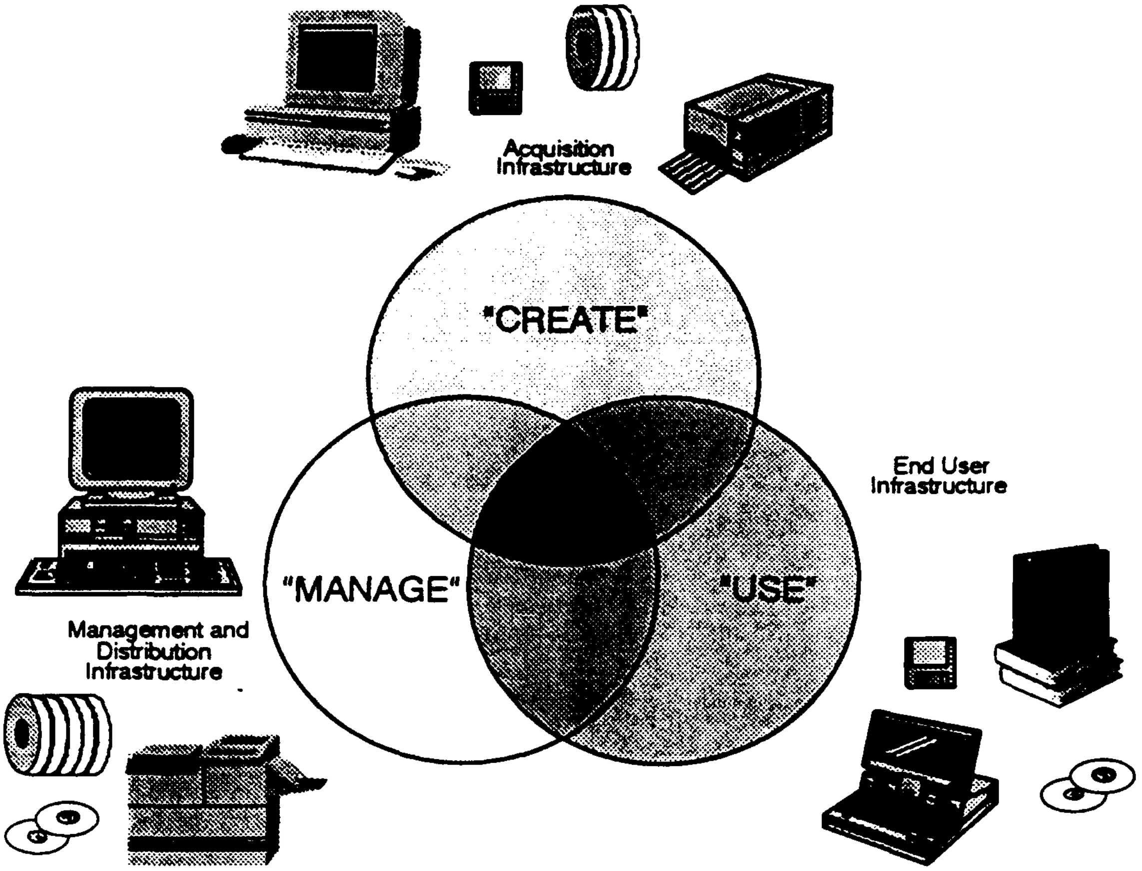


FIGURE 1. The Three Levels of Data Activity

1.2 Purpose

The planning processes for the creation, management, and use of TMs in a CALS environment needs to take advantage of the capabilities provic'ed by the automation and integration of information systems. Various format options are available for the delivery of TMs that are needed to define and support a defense system. The intent of this document is to:

- Provide an overview of the TM acquisition process
- Provide a step-by-step process for each TM decision
- Describe delivery options available for TM acquisition
- Provide a method to determine the cost associated with each option
- Provide guidance for specific contract language required to support the options selected
- Discuss contractor validation and Government verification procedures.

This document contains ordering information for the deliverable media and digital data format for TMs. The guidance in this document addresses the delivery consideration of TMs as defined in MIL-HDBK-59. The Contract Data Requirements List (CDRL) guidance contained in this document applies to all types of TMs.

2.0 REFERENCES

2.1 Acronyms

A complete list of acronyms used throughout the Desktop Guide is in Appendix A. The following acronyms are used in this section of the guide.

ADMAPS	Automated Document Management and Publishing System
ASCII	American Standards Code for Information Interchange
ATIS	Advanced Technical Information System
CALS	Computer-aided Acquisition and Logistics System
CALS RIC	CALS Resource and Implementation Cooperative
CALSIP	CALS Implementation Plan
CDRL	Contract Data Requirements List
CGM	Computer Graphics Metafile
CITIS	Contractor Integrated Technical Information Service
CLIN	Contract Line Item Number
CTN	CALS Test Network
DoD	Department of Defense
DoDI	DoD Instruction
DTD	Document Type Definition
EDI	Electronic Data Interchange
FOSI	Formatting Output Specification Instance
FRC	Final Reproducible Copy
GCO	Government Concept of Operations
IETM	Interactive Electronic TM
IGES	Initial Graphics Exchange Specification
ILS	Integrated Logistics Support
JEDMICS	Joint Engineering Data Management and Information Control System
LRU	Line Replaceable Unit
LSAR	LSA Record
NIFF	Navy Image File Format
OS	Output Specification
PC	Personal Computer
PDL	Page Description Language
SGML	Standard Generalized Markup Language
SOW	Statement of Work
SPAWAR	Space & Navy Warfare Systems Command
SPDL	Standard Page Description Language
TDP	Technical Data Package
TM	Technical Manual
TMCR	TM Contract Requirement
TMM	Technical Manual Manager
TMPODS	TM Print-On-Demand System
WRA	Weapon Replaceable Assembly

2.2 Definitions

Definitions used in this section and throughout the Desktop Guide are in Appendix A: Definitions.

2.3 Applicable Documents

Documents referenced in this section and throughout the Desktop Guide are listed in Appendix A: Applicable Documents.

3.0 GENERAL CONSIDERATIONS

The development of a CALS strategy for TMs needs to be carefully examined to maximize the value for a specific defense system program. Program attributes such as technology, costs, quantities, and schedules have a profound effect on the deliverable requirements of TMs. Therefore, the acquisition management team must consider the life cycle of the procurement and the Navy infrastructure in place to support the TMs for their program.

TMs are any technical publication or other form of documentation used to install, operate, maintain, test, repair, overhaul, or provide logistic support of ships, aircraft, defense systems, or defense material. TM data may be presented or delivered in any form including, but not limited to, hard copy, audio and visual displays, magnetic tape, discs, and other electronic devices. TMs are divided into three major categories; Description, Operation, and Maintenance with Illustrated Parts Breakdown; Installation and Checkout Procedures; and Technical Repair Standards. The acquisition guidance provided in this document will apply to these categories.

The following sections discuss various topics of consideration that must be addressed:

- TM Decision and Responsibility
- Identify/Establish the Requirement for the TM
- Identifying the TM User's Infrastructure
- TMs in a CALS Environment
- Life Cycle Considerations
- CDRLs.

3.1 TM Decision and Responsibility

The following sections of this document are devoted to the acquisition of TMs in a digital environment. The purpose of the flow chart (see figure 2) is to lead the acquisition management team through a logical series of decisions and responsibilities associated with the overall process of TM format and delivery media selection. Cost comparison information and recommended CDRL language is also provided.

The flow chart also recommends who specifically is accountable for performing each task and function or making a decision. In addition to identifying the responsible agency or agent for each of the tasks, functions, or decisions, this chart also identifies supporting agencies and their inputs as required.

NOTE: Shadowed task/function boxes alert the user of additional details and/or decision flow charts.

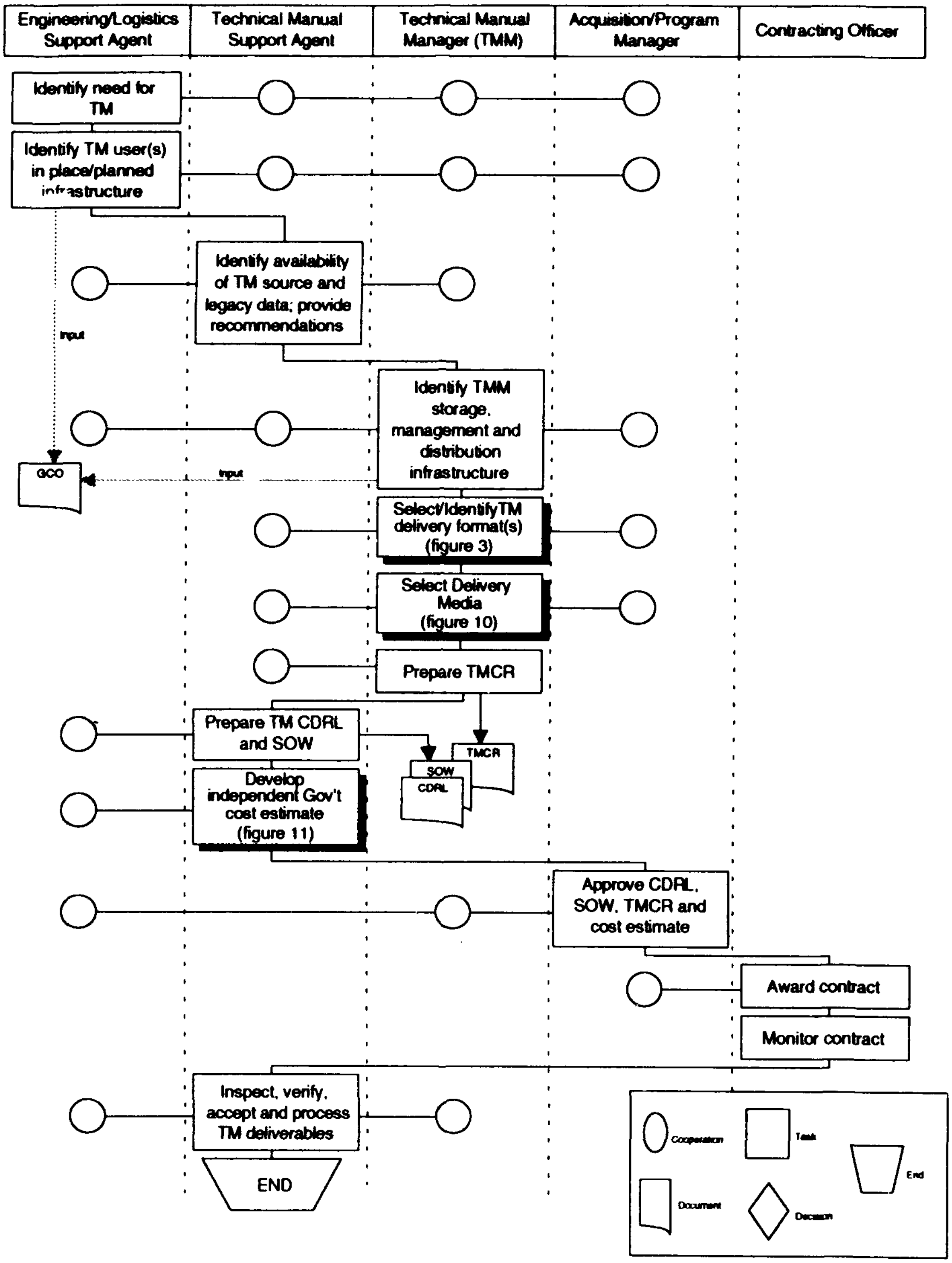


FIGURE 2. TM Decision and Responsibility Flow Chart

3.2 Identify/Establish the Requirement for the TM

The acquisition management team must first identify the requirement to procure a TM. This is usually brought about through the Logistic Support Analysis Record (LSAR) process and other requirements, such as the need to perform maintenance on the equipment. The LSAR database generated during the initial phases of the defense system program will usually define the requirement for particular TMs.

3.3 Identifying the TM User's Requirements

The acquisition management team must now identify the intended TM user's infrastructure. The users include: Those involved in the acquisition, review, and approval; the TM management infrastructure; and the end user (who may not yet operate in a digital environment). The acquisition management team should consider the existing and planned infrastructures for both Government and contractor facilities; available CALS data exchange standards; and the various digital data deliverable options in terms of media, format, and access. Documentation of this review will take the form of a Government Concept of Operations (GCO). The review will include:

- The identification of current, near, and midterm infrastructure plans for the enterprise
- The ability for peer-to-peer communication
- The throughput capability to support movement of data electronically using the installed telecommunications infrastructure
- The personnel and their disciplines at all locations that are members of the acquisition management team
- The digital data resources or source data (libraries of historical data, standards, and specifications) available to support program acquisition and logistics processes.

Provisioning for end user hardware and software requirements to support a fielded defense system are normally under the funding discretion of the acquisition management team and must be considered during the CALS implementation strategy and planning process.

A more detailed guidance is provided in section 4, Guide for Developing a CALS GCO, in the "Navy/Marine Corps Manager's Desktop Guide for CALS Implementation."

3.3.1 Infrastructure Development

Effective acquisition of digital data can be done only with full consideration of the ability of Naval Forces activities to receive, store, distribute, and use digital data that complies with the CALS standards. The acquisition management team must establish the uses for which the data is required (see 3.3.2) and the Navy infrastructure modernization programs (see Appendix C) available to support this data. In response to DoDI 5000.2, DoD components are incrementally upgrading the infrastructure toward a comprehensive technical information management architecture through joint service

programs like Joint Engineering Data Management Information and Control System (JEDMICS) (see Appendix C). The evolution of this infrastructure is a key consideration in implementing the CALS strategy on any given acquisition. Deficiencies in the Government's infrastructure may require investments by the acquisition management team to implement the CALS strategy effectively.

The availability of digital data processing and telecommunications technology and approved standards for creation, storage, transmission, data protection, and integrity of data at the time of delivery or access are important criteria for acquisition decisions. The current and projected capabilities of both the contractor and Naval Forces components must be assessed with respect to program needs and schedules. The GCO and CALS Implementation Plan (CALSIP) counterparts are excellent vehicles for making these determinations. The acquisition management team must plan to access or acquire digital data products.

The data user infrastructure, which is the computing environment available to a particular user, must be considered when acquiring digital data. This environment establishes the data processing capabilities of that user. The following areas identify a user's infrastructure:

- Hardware: Determine the current and planned hardware available to support the defense system program.
- Software: This is the most critical element. Interoperability will normally be achieved through the use of software. Again, determine both present and future software applications and availability.
- Networks: Determine the local- and wide-area networking capabilities and whether CITIS will be used.

The Navy infrastructure modernization programs specifically designed to aid in the creation, management, and use of TMs are:

- Automated Document Management and Publishing System (ADMAPS)
- TM Publish-On-Demand System (TMPODS)
- Advanced Technical Information Support/Interactive Electronic TM (ATIS/IETM)

An overview of these information management infrastructure programs is contained in Appendix C.

3.3.2 Data Uses

TMs are subject to all uses defined in MIL-HDBK-59. The acquisition management team will need to identify the use of the data by all organizations involved in the acquisition program. The acquisition management team must consider how data will be processed to make good decisions on digital data requirements. The five defined categories of data processing typical of most defense system programs are:

- View only: The ability to examine a data file without the ability to change it. This includes viewing selected portions of one or several documents as well as side-by-side comparisons of documents. This activity is an excellent candidate for applying the Contractor Integrated Technical Information Service (CITIS) concept.

- Comment/Annotate: The ability to evaluate and highlight for future reference or to make annotations, approvals, and comments without the ability to change the original file. Annotations are associated with a specific item or location within a document such that the annotations are displayed whenever that point or area of the document is displayed. Core CITIS functions (approve, comment, view) are intended to provide this capability and should be given consideration.

- Update/Maintain: The ability to change data, either directly or through controlling software, in the active files on the host computer.

- Extract/Process/Transform: The ability to extract and modify the format, composition, and structure of the data into another usable form.

- Archive: The placing of data into a repository to preserve it for future use.

3.4 TMs in the CALS Environment

The acquisition management team should be aware that it is possible to acquire TMs in a variety of forms depending upon the needs of the users. Maintenance manuals and the like may be procured as Interactive Electronic TMs (IETMs). The user would be the technician whose main concern is finding the desired maintenance-related information quickly and easily without being burdened in the field with the entire maintenance manual. On the other hand, description, operation, and installation and checkout manuals may be procured best in raster or Page Description Language (PDL) since these manuals are not used as often. Obviously, it is better to leave these decisions up to the individual program office since each defense system program is unique in its requirements.

Primary considerations for the acquisition management team to address when applying CALS to the creation, management, and use of TMs is the media, format, and content of TM data deliverables and their respective end users.

Paper, microfiche, and microfilm have been included in this discussion of CALS because much of the Navy's TM inventory is still available on these media. Navy CALS initiatives (see Appendix C, Navy Infrastructure Modernization Programs) are being developed to reduce or eliminate the need for these forms of media in the future. The benefits associated with using digital data far exceed what is being discussed in this paper. For TMs some benefits of digital data include: (1) Improving the handling and reducing the storage of TM data with electronic filing and archiving ideally creating a data repository; (2) reducing the costs associated with printing and distributing TMs by providing on-line access to this repository, so that naval personnel could access the data repository from their field activity and view and/or print the specific TMs they require; and (3) eliminating the need for field activities to incorporate change pages by keeping the data repository's TM data current. Also, this data repository may incorporate other related data to form a knowledge base to aid in the creation of IETMs.

3.4.1 Nondigital Data Deliverables

3.4.1.1 Paper

Paper or Final Reproducible Copy (FRC) has long been the traditional media for delivery of Navy product data and related information. TMs delivered on this media may have originated from many sources including other existing paper documentation, microfiche, microfilm, or any of the digital data formats described in the following sections. TMs originating on this media are governed by standards such as MIL-M-38784 and MIL-M-81927(AS).

Since paper is not a digital form of media, no digital data infrastructure requirements are necessary. However, converting the data content of paper to a digital data format requires infrastructure systems that include scanning hardware and software to support the conversion of both text and graphics from hardcopy to electronic format. The TM Print-On-Demand System (TMPODS) supports this type of paper-to-digital format conversion process (see Appendix C, TMPODS).

Since paper documents are difficult to maintain and update, it is not expedient to obtain them instead of digital data. Scan .ng a document into TMPODS is most useful when used with legacy data.

NOTE: The acquisition management team should accept paper deliverables only for the purpose of verifying the digital deliverables.

3.4.1.2 Microfiche/Microfilm

Microfiche and microfilm are other traditional media for delivery of data to the Navy. It is not a recommended media for obtaining new data, but it is discussed here since legacy data in this form already exists. The data provided on microfiche and microfilm are governed by specifications, such as MIL-M-38748 and MIL-M-9868, which provide guidelines for data format and content. Converting the data contents of microfiche or microfilm to a more flexible digital data format requires additional infrastructure requirements that include scanning hardware and software to support both text and graphics. TMPODS also supports the conversion of microfiche and microfilm to a digital form (see Appendix C, TMPODS)

3.4.2 Digital Data Deliverables

Digital data deliverables available in the CALS environment are extensive. Digital data provides the acquisition management team with a variety of digital data formats and media options. For TM delivery, the list includes:

Data Formats:

- Raster
- Illustrated Text Data Files:
  - a) Text:
    1) American Standards Code for Information Interchange (ASCII)
    2) Standard Generalized Markup Language (SGML)

b) Illustrations:
   1) Computer Graphics Metafile (CGM)
   2) Initial Graphics Exchange Specification (IGES)
   3) Raster

c) PDL

- IETM

Media:
- MIL-STD-1840 magnetic tape
- Magnetic disk
- Optical disk
- CITIS - interactive access

3.5 Life Cycle Considerations

TMs are developed using LSAR and engineering drawings as source data. The LSAR consolidates logistics-oriented technical information in conjunction with data from the various engineering disciplines and Integrated Logistic Support (ILS) elements to reduce redundancy, facilitate timely usage, and enhance consistency among data elements and disciplines. The quality and productivity of TM development are enhanced when the LSAR is used as a principal data source for this process. Integration of the databases that produce LSAR task analysis (and other) data, TMs, and training materials will provide even greater benefits to the defense systems program.

TMs are generally not required until the later acquisition life-cycle phases of a defense system program. In addition, TMs available during these earlier phases may be preliminary copies that have not been verified or have not received final acceptance but are useful for test verification, training, and operation. FRCs are available in the later phases. The acquisition management team must also consider the information volume and typical use (see 3.3.2) to determine the appropriate TM deliverable format.

3.6 CDRLs

Delivery of defense system data in digital form requires changes to Navy solicitations and contracts including their attachments and enclosures. These changes should be made with full consideration of the ability of Navy activities to make cost effective use of digital data deliverables or access. Each defense system program may include unique requirements for which additional program-specific tailoring will be needed. Most of the applicable CALS standards and specifications contain contract-negotiable options from which the acquisition management team must choose to satisfy program-specific requirements including multiple classes or types of data formats.

The TM Contract Requirements (TMCRs) will identify the types of TMs required and include language that specifies exactly how data will be delivered (including media, format, and content) under the contract. However, the TMCR does not address software TM requirements such as operator manuals, systems operator manuals, etc. In the case of software manuals, the Statement of Work (SOW) and CDRL will specify the TM-related data requirements and their preparation and delivery. CALS standards

should be invoked, whenever possible, for digital delivery of support products such as engineering drawings and TMs. The media for delivery such as magnetic tape, optical disk, or on-line (networks or telephone modems) should be compatible with Government-receiving system capabilities. Some digital deliverables, especially interim deliverables, may be efficiently acquired by agreeing on a common word processing package in the contract and specifying the appropriate and compatible physical media such as magnetic disk, magnetic tape, etc.

4.0 SPECIFIC CONSIDERATIONS

Once the general considerations have been reviewed, an additional process of determining how to implement these decisions must be accomplished. The information contained in this section provides a process for selecting which options are best suited for the defense system program objectives. It should be noted that certain considerations must be accomplished concurrently. The options must be evaluated for usefulness with respect to each phase of the defense system's life cycle and whether the defense system program's infrastructure can support a particular option. Once the most suitable options have been selected, the process to validate and verify these options should be determined.

The following sections discuss additional topics of consideration that must be addressed.

- Deliverable formats and media selection
- Determination of level of TM development or modification
- Cost issues associated with the selected deliverable option
- Sample language for contract deliverables.

4.1 TM Delivery Format Selection (see figure 3)

The purpose of this section is to determine the status and/or existence of the TM and ultimately to lead the acquisition management team to a decision as to the specific type of digital data and media format required to support the defense system program. In addition to the immediate TM requirements (acquire and/or develop a TM), an important consideration is that the acquisition management team should be concerned with the potential long term engineering and support functions and requirements when procuring the TM.

4.1.1 TM Delivery Options

4.1.1.1 Raster

Raster data is a binary representation of an image. Raster may be thought of as the electronic version of a paper document. It contains no intelligence and must be reviewed through human interpretation. There are two types of raster data, tiled and untiled. A tiled raster image resembles a two-dimensional grid with each "tile" or set of pixels representing a portion of the image. Formatted raster can be either tiled or untiled. Text and graphics in raster data formats are stored digitally, which allows more rapid and consistent access to the stored images than paper. In addition, raster data formats can be sent via electronic means to remote sites. Through a difficult process, raster files can also be converted to digital (word processor or desk top publishing) documents and edited through manipulation of individual pixels.

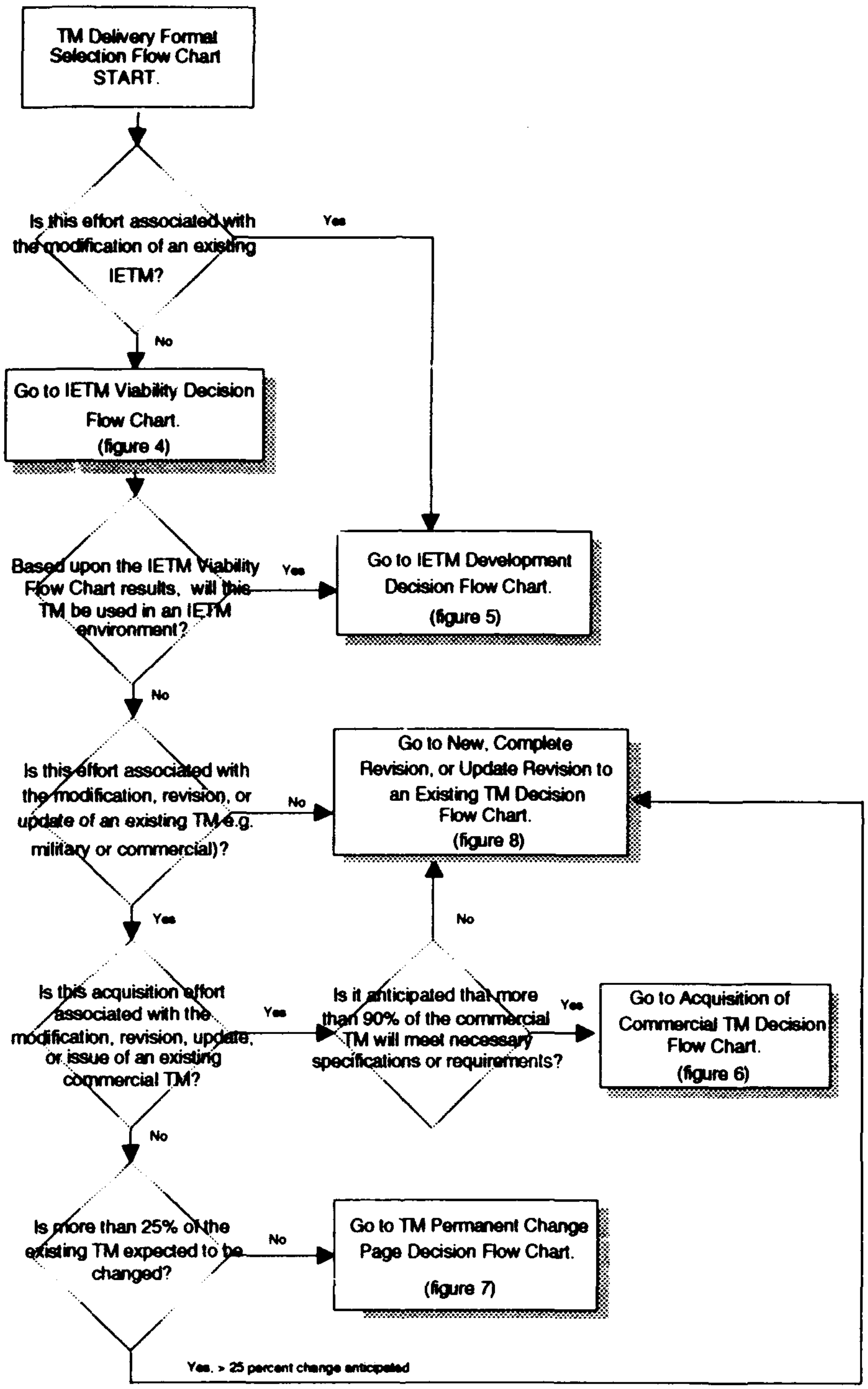


FIGURE 3. TM Delivery Format Selection Flow Chart

With the advent of raster scanning technologies, the ability to convert existing paper TM to digital data files has become available. Raster conversion became the easiest and most cost effective method for digitizing the Navy's existing paper TMs. However, the quality assurance (QA) process by human interpretation required to verify the data contents may increase costs substantially. Also, raster image files require a large amount of memory storage due to their file structure and contain no additional

information other than each tile's position on a grid. Technologies are evolving that will be able to convert the raster images to other digital forms (such as vector) for processing, but the acquisition management team should consider other processable data form's first unless the TMs required are legacy data. TMPODS stores drawing images as raster data on optical disk media (see Appendix C, TMPODS).

4.1.1.2 Illustrated Text Data Files

Illustrated text data files provide a dynamic form of source data with two possibilities: (1) Separated files for text, graphics, alphanumeric and audio/visual data; or (2) integrated files consolidating some or all of these different data representations. Text data files include word processing and desk top publishing applications. Such data files can provide the source data for multiple data applications that allow creation of standard and custom documents as well as manipulation of the data for annotate/excerpt or update/maintain purposes. Illustrated text data files can also import generic text [ASCII, SGML (MIL-M-28001), etc.] and graphics [raster (MIL-R-28002), CGM (MIL-D-28003), IGES (MIL-D-28000), etc.] from other sources that may be otherwise incompatible. In addition, there are PDLs, sometimes called text presentation metafiles, which are used to drive output devices such as printers.

There may be instances when obtaining illustrated text data files involves obtaining more than one format of graphical data. This may be due to multiple graphic sources. This is an acceptable and highly likely situation. The acquisition management team must be aware of this possibility and be prepared to develop/modify the defense system contract requirements accordingly.

Text Formats:

There are two possible text formats for consideration. They are the ASCII and tagged ASCII or Standard Generalized Markup Language (SGML). They are described below.

- ASCII

  ASCII was developed as a method of translation for computer processors to interpret alphanumeric characters and symbols through binary representation. ASCII is the basic text information used by most word processing applications and contains no formatting information other than line feed and/or carriage returns. Word processing applications can import ASCII text from other word processing applications, and some word processing applications can translate formatted ASCII from other word processing applications into their own format. This makes ASCII text ideal for most interim deliverables since it can also be imported into an SGML application where it can be SGML-tagged to become a CALS-compliant deliverable.

- SGML

  SGML as defined in MIL-STD-1840 is "A standard that defines a language for document representation which formalizes markup and frees it of system and processing dependencies. It provides a coherent and unambiguous syntax for describing whatever a user chooses to identify within a document." In the SGML scheme, the document contains only generic tags identifying such

structural elements as paragraphs, sections, etc. but no typesetting markup. However, SGML's tagging of ASCII text is a rather cumbersome proposition and may be best suited for final data deliverables rather than interim deliverables. When considering SGML as a deliverable format, the acquisition management team must determine whether the necessary computer environment is available and in place to accept the SGML documentation. Any TMs that will be maintained throughout the life cycle of a defense system should be delivered in SGML format. The Format Output Specification Instance (FOSI) is an application that can output the same SGML document in different formats. The same SGML tagged document could have two or more FOSI's so that the same document can be printed on different publishing systems. Additional features associated with SGML are described in Appendix A [see Document Type Definition (DTD), Output Specification (OS), and FOSI].

Graphics and Illustration Formats:

There are three possible graphics formats for consideration. They are Computer Graphics Metafile (CGM), Initial Graphics Exchange Specification (IGES), and raster. They are described below.

- CGM

  CGM data is a two-dimensional vector presentation used primarily for charts, figures, and simple drawings. Many types of TMs contain illustration data in this category. This is the preferred format for obtaining graphical digital data into TMs. CGM requirements are stated in MIL-D-28003.

- IGES

  IGES data is a three-dimensional vector presentation used primarily for engineering drawings. IGES may be the preferred choice for graphical data if a CAD database was used as the source. IGES requirements are stated in MIL-D-28000.

- Raster

  See 4.1.1.1 for discussion of raster.

PDL:

A PDL file is executed by an interpreter that controls a raster printer or other output device. A PDL can be used to ensure that the composed document produced by an electronic publishing system (which may impose additional processing limitations, such as font variations, kerning, or hyphenation) would produce nearly identical hardcopy output on the widest possible spectrum of printer devices. MIL-STD-1840 provides for the interchange of PDL data files. However, PDLs are currently not standardized, for a Standard Page Description Language (SPDL) is still being developed. MIL-STD-1840 requires that a system must provide portability of files (PostScript or Impress PDL specifications). PDL document image files can be acquired as interim deliverables or as final deliverables in addition to, but not in place of, other digital data deliverables.

4.1.1.3 Interactive Electronic TM (IETM)

An IETM is a computer-based collection of information needed for the diagnosis and maintenance of a defense system. It is optically arranged and formatted for interactive presentation to the end user on an electronic display system. Unlike other optical systems that display a page of text from a single document, IETMs present interrelated information from multiple sources tailored to user queries. Currently, IETMs are being developed by the AEGIS program to run on the ATIS platform (see Appendix C).

Specifications and other items to define IETMs are:

- MIL-D-87269, *Data Base, Revisable: Interactive Electronic Technical Manuals, for the Support of*
- MIL-M-87268, *Manuals, Interactive Electronic Technical: General Content, Style, Format, and User-Interaction Requirements*
- MIL-Q-87270, *Quality Assurance Program: Interactive Electronic Technical Manuals and Associated Technical Information; Requirements for*
- Hypertext and Hotspots.

A hypertext document consists of a collection of "interconnected writings." These interconnections allow a user to browse through a document by selecting points of interest or hotspots that may be connected to other related hotspots or menus. The user could then continue to follow along these "paths" to other cross-referenced points in that collection of writings. This creates a "pageless" document that, depending on the source database, can contain a collection of information from a variety of sources. Also, rather than limit these documents to pure text, we may incorporate graphics, audio, video, and/or computer programs into the content of the document creating what is known as a hypermedia document.

By streamlining access to the desired information and by providing multiple paths to other related information, the IETM offers a more efficient and more comprehensive method of using technical information. Unrestricted by the page-oriented display and the use of sole-source information, the IETM duplicates on the personal computer (PC), the research environment available in a well-equipped multimedia library; displays only the actions appropriate for resolving a specific problem; provides fault-isolation tables and diagrams; and guides the technician through the troubleshooting process via a user-friendly query method. IETMs permit the user to locate information more easily and to present it faster and more comprehensively in a form that requires much less storage than paper.

Derived from the LSAR and CAD data, the IETM will inherently become an integral part of the defense system for the outset. Data created throughout the defense system's life cycle will contain all of the information needed to create and revise the necessary IETMs for the program.

IETMs require a computer environment with the appropriate presentation systems and software to invoke them.

4.2 IETM Viability (see figure 4)

The acquisition management team should consider whether the TM will ultimately be used in an interactive computer environment, the IETM. The IETM format offers the user distinct advantages over the traditional TM. Some IETM benefits include: (1) Reduction in the false removal rate of Line Replaceable Units (LRUs) or Weapon Replaceable Assemblies (WRAs); (2) reduction in troubleshooting time; (3) reduction in the TM support costs associated with distribution, management, and storage; and (4) allowing training activities to concentrate more on generalized training vice system specific training. The acquisition management team should first determine whether the end item or defense system program is currently in the early phases of design, whether the life cycle requirements for the TM exceed five years, <u>and</u> whether the TDP or LSAR database contains, or can be economically altered to include, a numbering system similar to MIL-STD-1808. If <u>any</u> of these considerations can be answered "NO," then an IETM is not recommended; proceed to 4.4. If <u>all</u> considerations can be answered "YES," then a business case analysis should be performed to determine the economic feasibility of the IETM. If results from this analysis recommend pursuing an IETM <u>or</u> quality readiness and/or support factors lend adequate credence to the need for an IETM, development of an IETM should be pursued. In this case, go to 4.3.

4.3 IETM Development (see figure 5)

Once IETM development has been selected, the acquisition management team must first determine whether this effort will be associated with an existing IETM. This may include the modification of an existing IETM <u>or</u> the creation of a supplement to an existing IETM. If this is indeed the case, then the acquisition management team must determine whether an existing infrastructure and display device will be used in conjunction with the IETM <u>and</u> whether this infrastructure uses a proprietary format. If <u>all of the above</u> conditions are true, then the final IETM developed should remain in the existing proprietary format. However, if <u>any</u> of these conditions is not met, then it is advised that the IETM be developed using the new IETM standards. See "NOTE" below and proceed to 4.8.

NOTE: For both cases stated above, any existing source or legacy data used to develop the IETM that is not presently in a digital format should be converted to an acceptable digital format for proper utilization in the IETM format. All appropriate standards and specifications should be used in converting and/or developing the required data.

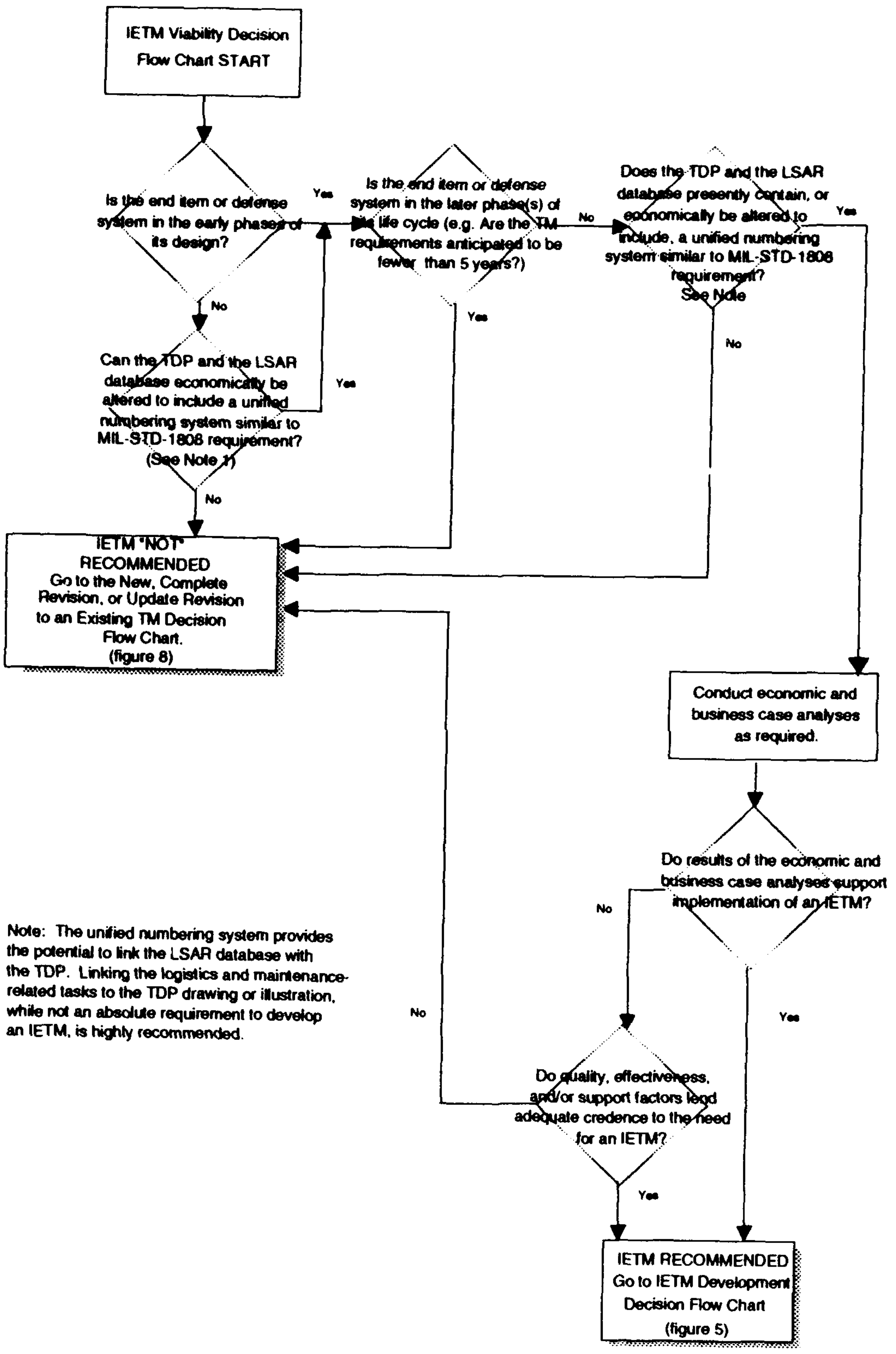


FIGURE 4. IETM Viability Decision Flow Chart

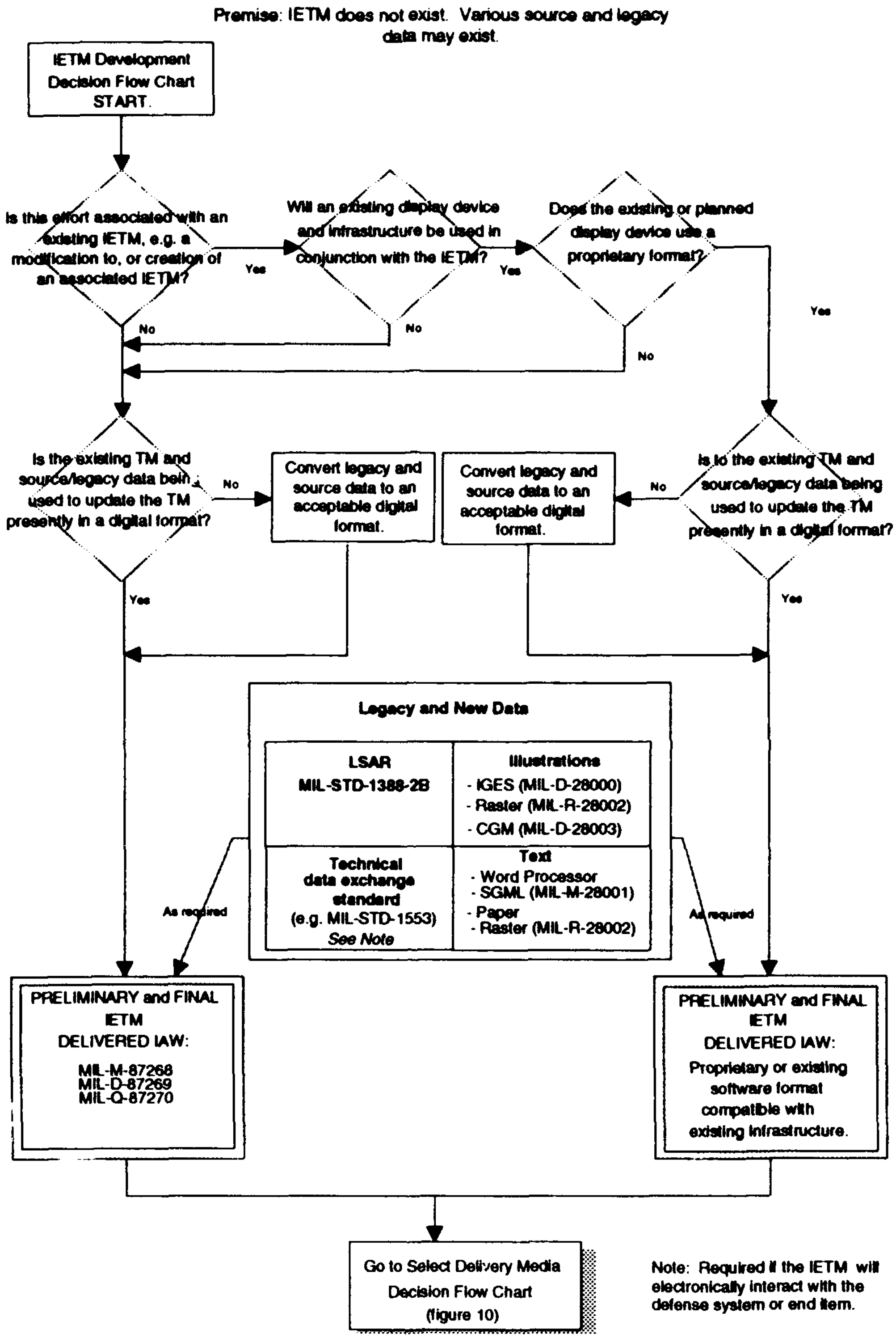


FIGURE 5. IETM Development Decision Flow Chart

4.4 Existing TM Availability

Utilization of existing TMs and legacy data is likely in the development of completely new systems with similar features. The acquisition management team should be aware that even on completely new defense system programs some portion of the TMs may exist in both digital and nondigital formats. This is most relevant when a program is entering the earlier life cycle phases. An important point to remember here is that acquisition of the proper level and type of digital data is most cost effective when defined early in the program's life cycle. If the TM does not exist and/or is not accessible to the Government, the acquisition management team should consider developing a new TM (see figure 8 and 4.5). If the TM does exist, the acquisition management team should proceed to 4.4.2, unless the acquisition effort is associated with the modification, revision, update, or issue of an existing commercial TM. In that case, go to 4.4.1.

4.4.1 Commercial TM Usage

Another consideration the acquisition management team must address is whether existing off-the-shelf TMs will satisfy the program's TM requirements. If **more than 90 percent** of the TM conforms to the technical content requirements defined in MIL-M-7298 and supports the maintenance concept of the equipment, the commercial TM may be used. In this case, go to 4.4.1.1. However, if **more than 10 percent** of the proposed TM fails to meet the necessary requirements to support the equipment, a new TM should be developed. If this is the case, go to 4.5.

4.4.1.1 Commercial TM Development (see figure 6)

Once it has been determined that a commercial TM will satisfy the technical requirements and maintenance concept of the equipment, the acquisition management team must determine the present format of the commercial TM and whether change pages and/or a TM supplement will be required. If the "basic" TM is available in a word processor format, the TM may be delivered in its present format providing that this is mutually compatible with the existing infrastructures. In this case, go to 4.7. If it is not, the TM should be delivered in raster format. In this case, go to 4.6. Also, if change pages and/or a TM supplement will be required in addition to, or instead of, the "basic" TM, then the development of these items is the same as that required for a new TM except that the format and style of the newly developed items may remain the same as the "basic" TM. Go to 4.5.

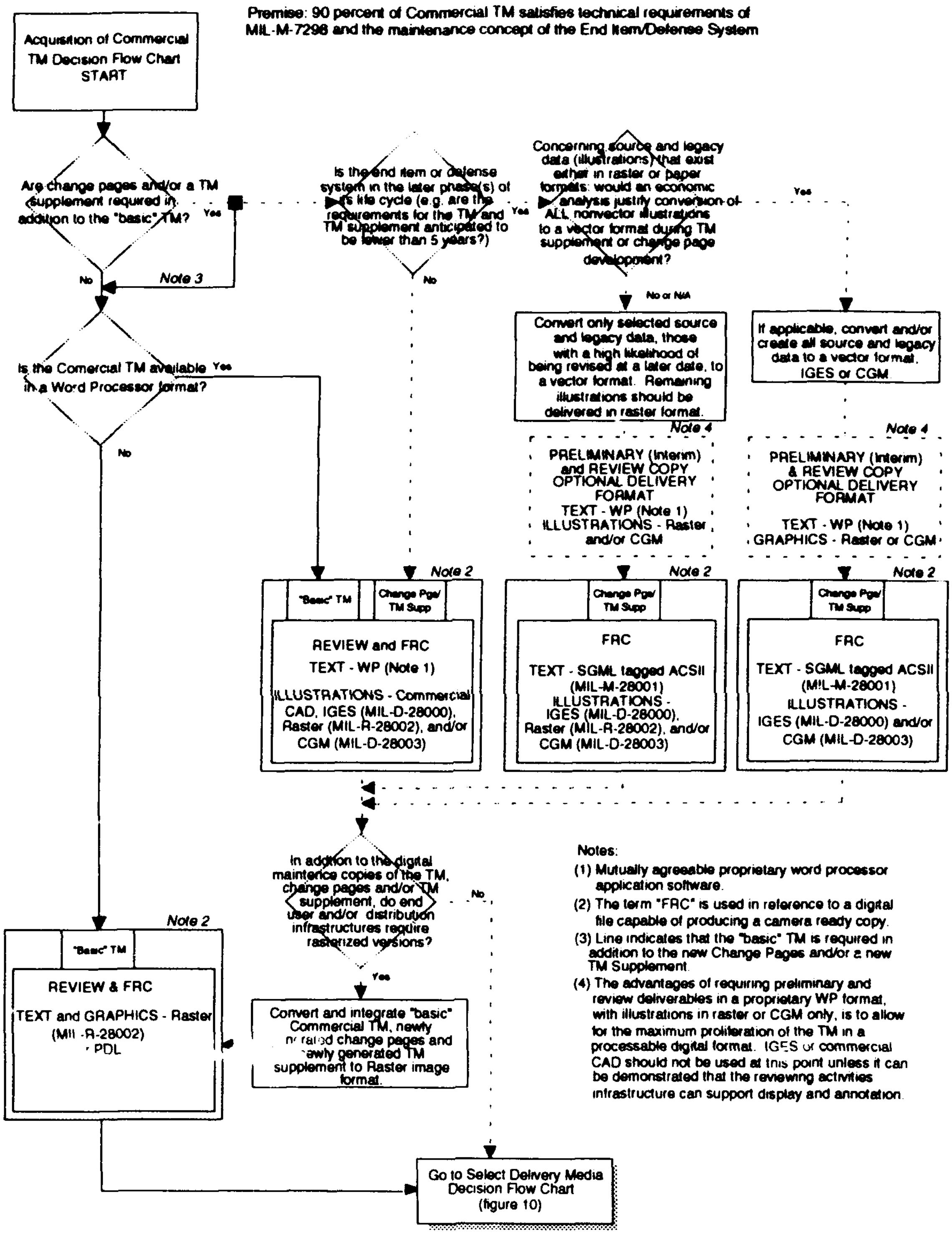


FIGURE 6. Acquisition of Commercial TM Decision Flow Chart

4.4.2 Revisions to Existing Military TMs

The acquisition management team must now determine how well the existing military TMs cover the maintenance concepts of the equipment. Changes to the hardware configuration or equipment components of the defense system may impact upon the accuracy of the TM's information. If **less than 25 percent** of the TM is affected by configuration changes, proceed to 4.4.2.1. If **more than 25 percent** of the existing TM is affected by these configuration changes, complete revision of the TM is recommended. Proceed to 4.5. However, if the configuration changes affect the existing TM in a range somewhere in between these two extremes, proceed to 4.4.2.2.

4.4.2.1 TM Permanent Change Page Development (see figure 7)

Once it has been determined that less than 25 percent of the TM needs revision, only change pages will be developed. The basic TM will be converted to raster if it is not already digitized. Change page development will follow the same decision path as the development of a new TM, but the newly created change pages will retain the format and style of the original TM. Proceed to 4.5.

4.4.2.2 TM Update Revision Development

Once it has been determined that more than 25 percent of the TM must be changed, the acquisition management team must decide how the final product will be delivered. The decision process follows the same basic path as that stated for a newly developed TM (see figure 8); the difference is the revised TM may retain the format and style of the original TM. Proceed to 4.5.

4.5 New TM, Complete Revision, or Update Revision Development
(see figure 8)

4.5.1 Source and Legacy Data Considerations

The acquisition management team must now consider whether any of the TM source data presently exists as legacy data. Legacy data developed from existing defense systems or from the creation of LSA data may contain enough information to warrant inclusion into the new defense system program.

NOTE: For newer defense system programs, this legacy data may exist in both digital and nondigital formats.

Premise: Less than 25 percent of the existing TM expected to be changed.

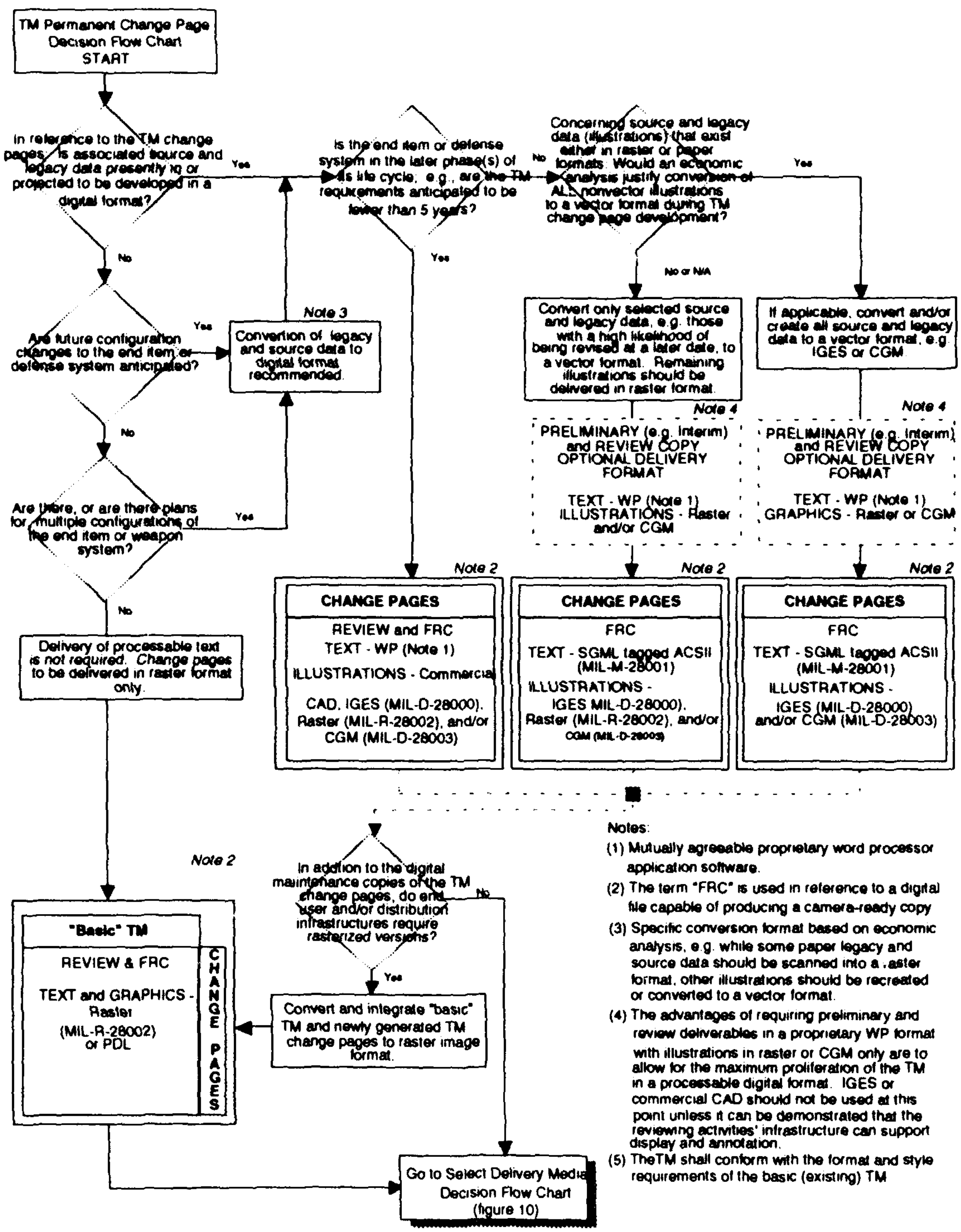
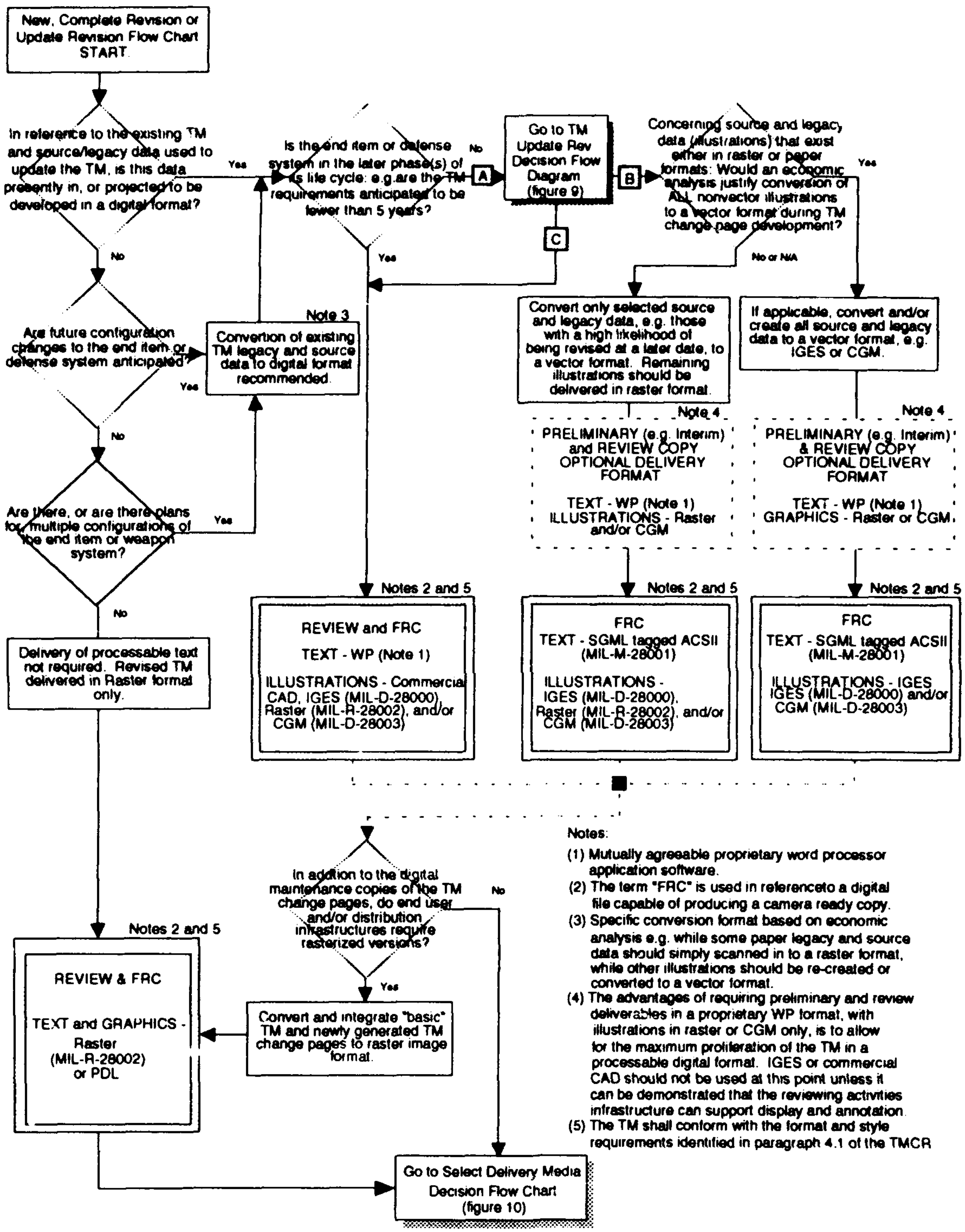


FIGURE 7. TM Permanent Change Page Decision Flow Chart

Premise: TM does not exist in any form, or more than 25% of the existing TM is expected to be changed.



Notes:

(1) Mutually agreeable proprietary word processor application software.

(2) The term "FRC" is used in referenceto a digital file capable of producing a camera ready copy.

(3) Specific conversion format based on economic analysis e.g. while some paper legacy and source data should simply scanned in to a raster format, while other illustrations should be re-created or converted to a vector format.

(4) The advantages of requiring preliminary and review deliverables in a proprietary WP format, with illustrations in raster or CGM only, is to allow for the maximum proliferation of the TM in a processable digital format. IGES or commercial CAD should not be used at this point unless it can be demonstrated that the reviewing activities infrastructure can support display and annotation.

(5) The TM shall conform with the format and style requirements identified in paragraph 4.1 of the TMCR

FIGURE 8. New, Complete Revision, or Update Revision to an Existing TM Decision Flow Chart

If legacy data does exist in a digital format, the acquisition management team should proceed to 4.5.3 to address life cycle considerations. If no legacy data is to be procured for the defense system's TMs or no digital legacy data exists, the acquisition management team should consider whether configuration changes and/or multiple configurations are anticipated for the end item or defense system. Go to 4.5.2.

4.5.2 Defense System Configuration Considerations

Configuration differences may play an important part in the acquisition of defense system TMs. The differences may be as small as printed circuit card modifications or as large as entire equipment changes. The acquisition management team must determine whether multiple configurations will exist. A different TM may be procured for each configuration. Another consideration is whether future changes to the TM are anticipated. If multiple configurations and/or configuration changes are anticipated, conversion of the source or legacy data to digital format is recommended. Specific conversion format may be based on an economic analysis that may recommend some paper legacy and source data simply be scanned into a raster format and other illustrations be recreated/converted to a vector format. In this case, proceed to 4.5.3. If this is not the case, the defense system program should consider delivery of the TM in raster format for both text and graphics. Go to 4.6.

4.5.3 Program Life Cycle Considerations

The acquisition management team must now consider the current phase of the end item or defense system program and the anticipated requirements for the TMs. If the end item or defense system program is currently in the later phase(s) of its life cycle and the TM requirements are anticipated to be **fewer than five years**, the need to deliver SGML-formatted TMs is not recommended, especially since most of the data for the TMs may be in hard copy or proprietary digital format. If this is indeed the case, delivery of both review and Final Reproducible Copies (FRC) of the TMs in a mutually agreeable format is recommended. Go to 4.7. If the TM requirements are anticipated to be **at least five years** and this TM development process is concerned with a TM Update Revision, proceed to 4.5.4. Otherwise, go to 4.5.5.

NOTE: The term "FCR" is used in reference to a digital file capable of producing a final reproducible copy.

4.5.4 Additional TM Update Revision Decisions (see figure 9)

As discussed in 4.4.2.2, a TM Update Revision may retain the style and format of the original TM. With this in mind, additional considerations concerning SGML formatting arise. DTDs may exist that support the modification of the original TM while retaining the original style and format. If these DTDs do exist, then proceed to 4.5.5. If these DTDs do not exist, then the acquisition management team must consider, through economic analysis, whether it is cost effective to modify or create a DTD to satisfy the style and format requirements of the original TM. If it is determined to be economically practical, proceed to 4.5.5. If not, it is recommended that the new TM Update Revision be delivered in a mutually agreeable format for both text and illustrations. Go to 4.7.

Premise: TM changes over 25 percent.

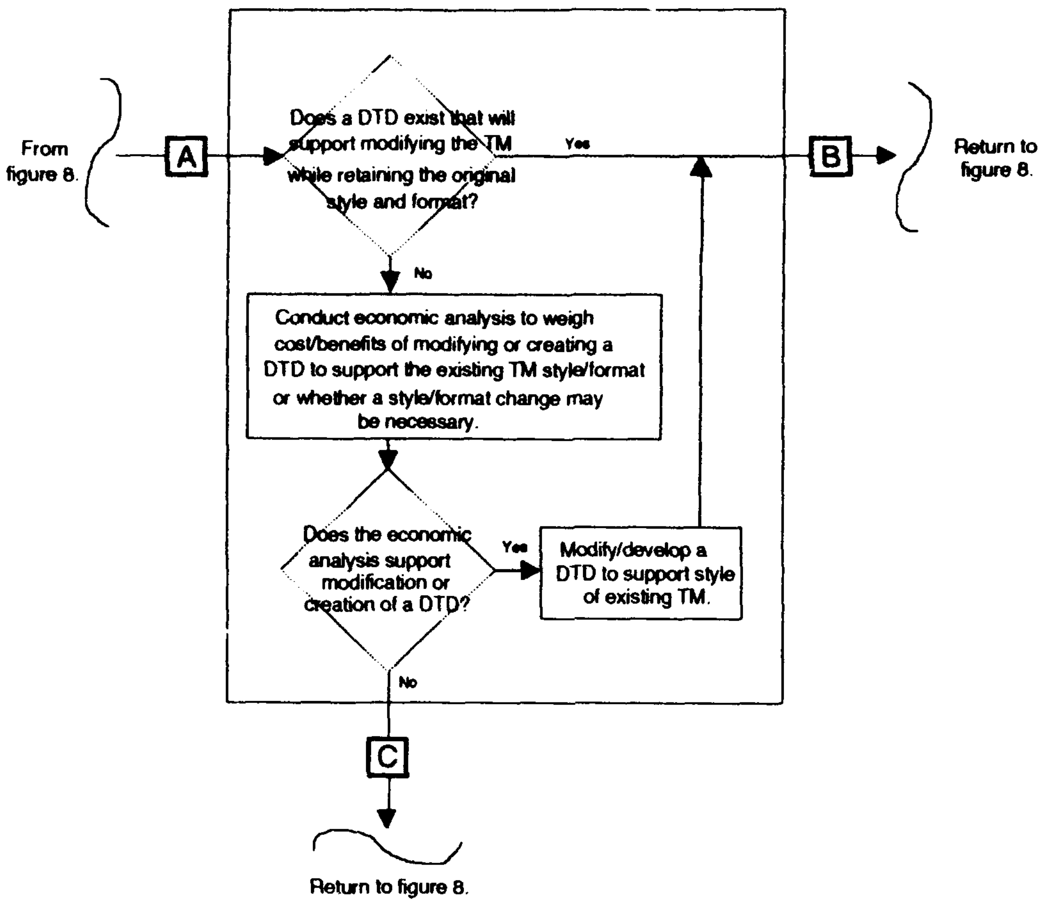


FIGURE 9. TM Update Revision Decision Flow Chart

4.5.5 Conversion of Illustrations

The acquisition management team must now determine, through economic analysis, whether conversion of **all** existing illustrations is justified. Conversion in this case means converting nonvector illustrations, both source and legacy data that currently exists in ras[illegible] and ha[illegible]rmats, into a vector format. If it is determined that conversion [illegible]ng nonvector illustrations to a vector format is cost effective or if no source or legacy illustrations exist, then the recommended solution would be to convert and/or create all applicable illustrations to a vector format, IGES or CGM. If economic analysis determines that conversion of all existing illustrations is not practical, it is recommended that only selected source or legacy illustrations (those with a high likelihood of being revised at a later date) be converted to a vector format. Remaining illustrations should be delivered in raster format. In either case, see "NOTE" and go to 4.7.

NOTE: To provide maximum proliferation of the preliminary TMs for review, it may be beneficial to request that these deliverables be provided in a proprietary word processor format with illustrations in either raster and/or CGM formats only. SGML, IGES or commercial CAD should not be used at this point unless it can be

demonstrated that the reviewing activities' infrastructure can support display and annotation.

4.6 Document Image Files (Raster, PDL)

The document image file delivery option, which consists of either raster (see 4.1.1.1) or PDL (see 4.1.1.2) files, allows the acquisition management team to obtain TM data in a digital format. The data uses of the document image file deliverables are somewhat limited but do provide for view, archive, comment, and annotate capabilities. Also CITIS, if available, provides another method for delivery of preliminary deliverables. The GCO is designed to assist the acquisition management team in determining CITIS availability. Suggested delivery media options (see figure 10) include: (1) Optical disk or CD-ROM, (2) Magnetic disk, or (3) 9-track magnetic tape, all in accordance with MIL-STD-1840.

NOTE: Paper TMs may be requested in addition to the document image file deliverables but only for verification of the document image file data.

4.6.1 Cost

Once the data delivery format selected is in document image files, the cost of acquiring this data can be calculated. Figure 11 is designed to assist the acquisition management team in determining all the steps associated with both the creation and/or conversion of the TM deliverable and, used in conjunction with table 1, will determine the approximate total cost of this process. Costs associated with paper TM delivery and/or on-line delivery using CITIS have not been included in this document.

NOTE: Table 1 provides an approximation of costs associated with this data deliverable. Specific program requirements may vary from those presented here and may be substituted for the rates shown.

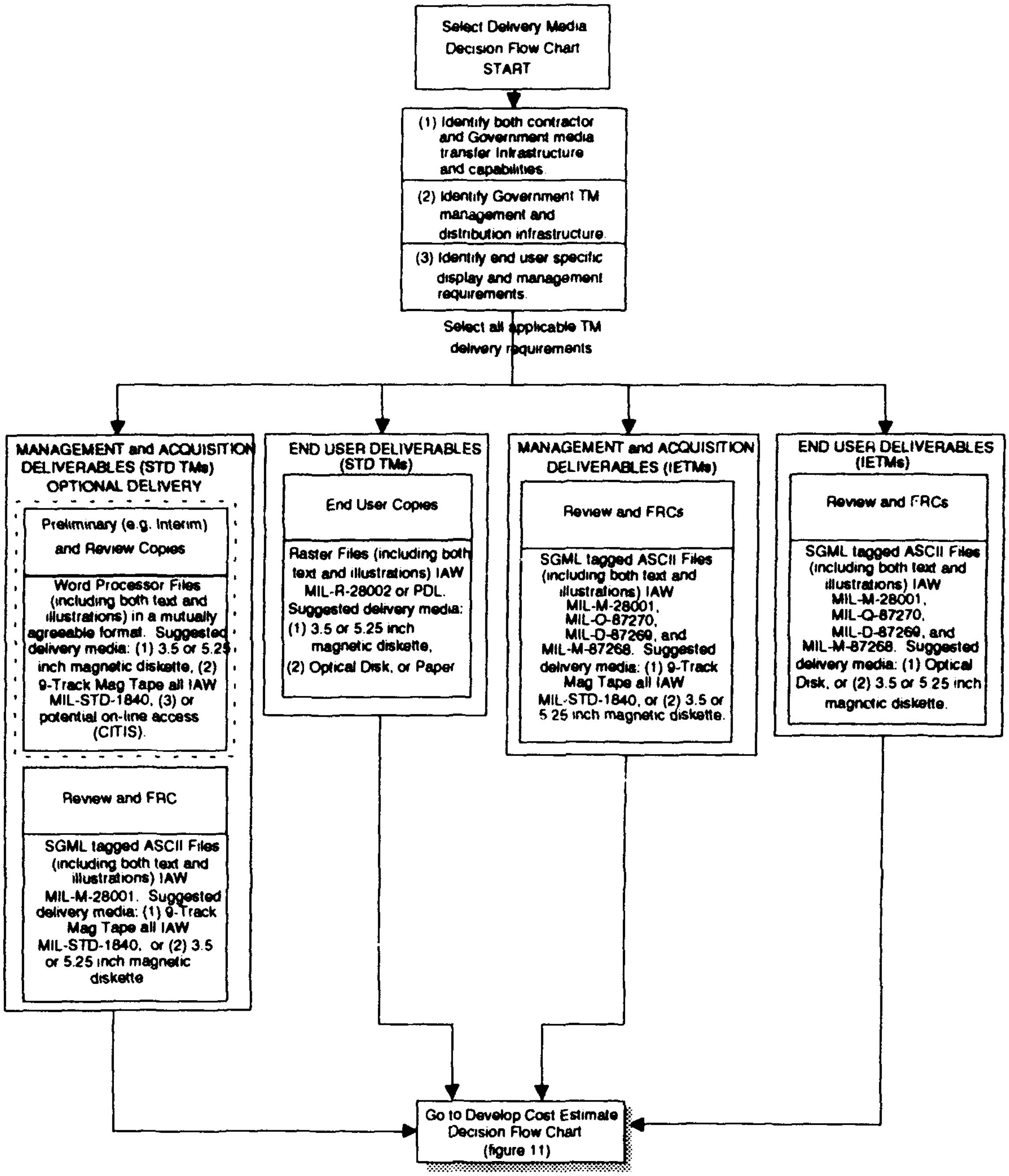


FIGURE 10. Select Delivery Media Decision Flow Chart

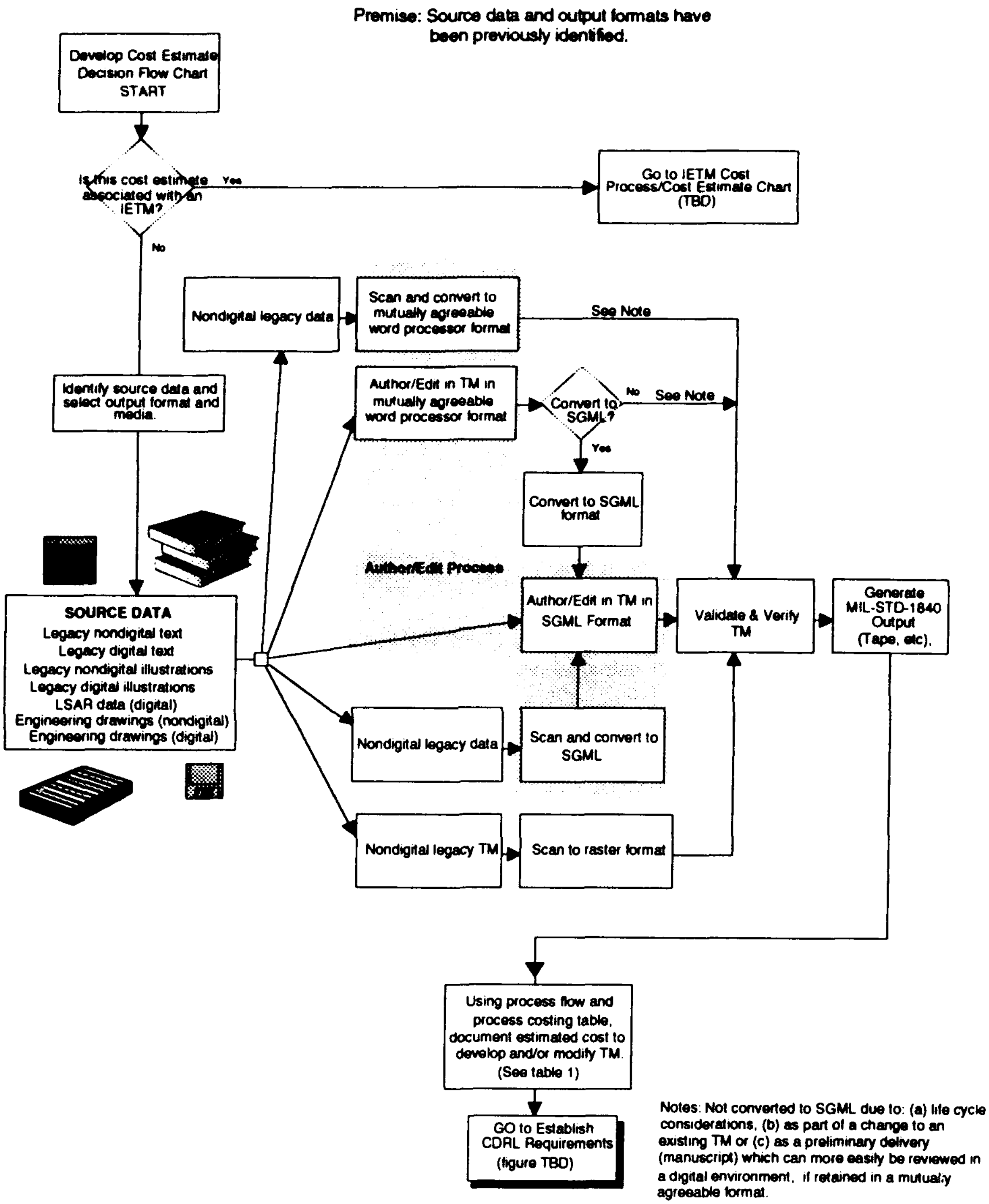


FIGURE 11. Develop Cost Estimate Decision Flow Chart

TABLE 1. Cost Associated with Developing/Converting the Deliverable Options

Process	Note 1	Text	Parts Lists	Tables	Block Diagm	Line Art	Schematic or Wiring Diagrams	Exposed Views
	S	4.0	4.0	4.0	4.0	5.0	6.0	15.5
Create in WP format	I	6.0	5.5	5.5	6.5	7.0	8.0	20.0
	C	12.0	7.0	7.5	9.0	9.0	10.0	40.0
	S	3.0	3.0	3.0	4.0	5.0	6.0	15.5
Create in SGML format	I	4.5	4.5	4.5	6.5	7.0	8.0	20.0
	C	9.0	5.5	6.0	9.0	9.0	10.0	40.0
Scan & Convert to WP		$16.00/Pg						
Scan & Convert to SGML		$16.00/Pg						
Scan & Convert to Raster		$2.00/Pg						
Convert from WP to SGML		$14.00/Pg						
Validate/Verify TM		0.5 hr/Pg						

4.5.2 CDRLs

To invoke this data deliverable option, specific TMCRs and CDRLs must be developed to identify the types of TMs required and include language that specifies exactly how data will be delivered under the contract including media, format (in this case raster), and content. To invoke this data deliverable option, a sample CDRL and a TMCR addendum sheet (see figures 12 and 13) have been developed. The sample CDRL may be used for any of the deliverable options by specifying the required deliverable as indicated. The information contained in the following contract vehicles should be tailored to meet the requirements of the specific defense system program. CALS standards should be invoked whenever possible.

CONTRACT DATA REQUIREMENTS LIST
(Data Item)

Form Approved
OMB No. 0704-0188

[illegible]

A. CONTRACT LINE ITEM NO.

B. EXHIBIT

C. CATEGORY
TDP ____ TM _X_ OTHER __________

D. SYSTEM/ITEM

E. CONTRACT/PR NO.

F. CONTRACTOR

1. DATA ITEM NO.

2. TITLE OF DATA ITEM
(Defense System)

3. SUBTITLE
(Specify Deliverable)

4. AUTHORITY (Data Acquisition Document No.)
SEE BLK 16

5. CONTRACT REFERENCE

6. REQUIRING OFFICE

7. DD 250 REQ
DD

8. APP CODE
A

9. DIST STATEMENT REQUIRED
D

10. FREQUENCY

11. AS OF DATE

12. DATE OF FIRST SUBMISSION

13. DATE OF SUBSEQUENT SUBMISSION

14. DISTRIBUTION

a. ADDRESSEE	b. COPIES Draft	Final Reg	Final Repro
15. TOTAL			

16. REMARKS

BLK 4: (Add TMCR No./Statement of Work Paragraph No.)
Note: Requirements should be specified in TMCR/Statement of Work.

BLK 9: See TMCR (Add No.) for Distribution Statement.

Note: See General DD Form 1423 Glossary for instructions on completing this form.

G. PREPARED BY

H. DATE

I. APPROVED BY

J. DATE

DD FORM 1423-1, JUN 90

FIGURE 12. Sample CDRL for TM Deliverables

TMCR Attachment (1)

ADDENDUM SHEET

The descriptions below identify any deviations/waivers or additions to the requirements defined in the referenced TMCR paragraphs.

TMCR Paragraph No.	Description
4.1.a	The text and tabular material for both the review and final manuscript copies shall be delivered in a raster data file. Navy Image File Format (NIFF) shall be used for the raster data contained in a MIL-R-28002 raster data file. Additional requirements for raster data files are contained in SPAWAR-S-903.
4.1.b	The illustrations and drawings shall be delivered in a raster data file. Navy Image File Format (NIFF) shall be used for the raster data contained in a MIL-R-28002 raster data file. Additional requirements for raster data files are contained in SPAWAR-S-903.

FIGURE 13. Sample TMCR Addendum Sheet for Raster Deliverables

NOTE: This addendum sheet was developed using Space and Naval Warfare Systems Command (SPAWAR) TM Contract Requirement (TMCR). Any specific paragraphs listed in this TMCR addendum sheet reference this document.

4.7 Illustrated Text Data Files

The illustrated text data file deliverable option, described in 4.1.1.2, includes the vast majority of data formats available to the acquisition management team. Illustrated text data file deliverables provide the greatest flexibility and data manipulation capabilities. It is very important that the acquisition management team know the specific digital and management infrastructure and end user requirements when specifying this deliverable option due to the number of digital formats and software applications available. Also CITIS, if available, provides another method for delivery of preliminary deliverables. The GCO is designed to assist the acquisition management team in determining CITIS availability. Suggested delivery media options, which may vary depending on the specific user's requirements (see figure 10), include: (1) Optical disk or CD-ROM, (2) Magnetic disk, or (3) 9-track magnetic tape, all in accordance with MIL-STD-1840.

NOTE: In addition to the digital maintenance copies of the TM, change pages, or TM supplement, a rasterized version may also be required by the end user and/or the distribution infrastructures. If this is the case, convert and integrate the new change pages or TM supplement, as applicable, into the rasterized "basic" TM.

NOTE: Paper TMs may be requested in addition to the digital data deliverables but only for verification of the digital data.

4.7.1 Cost

Once this option has been selected as the data delivery format, the cost of acquiring this data can be calculated. Figure 11 is designed to assist the acquisition management team in determining all the steps associated with both the creation and conversion of the TM deliverable and, used in conjunction with table 1, will determine the approximate total cost of this process.

NOTE: Table 1 provides an approximation of costs associated with this data deliverable. Specific program requirements may vary from those presented here and may be substituted for the rates shown.

4.7.2 CDRLs

To invoke this data deliverable option, specific TMCRs and CDRLs must be developed to identify the type of TM required and include language that specifies exactly how data will be delivered under the contract including media, format (in this case a processable text data file), and content. To invoke this data deliverable option, a sample CDRL and a TMCR addendum sheet (see figures 12 and 14) have been developed. The sample CDRL may be used for any of the deliverable options by specifying the required deliverable as indicated. The information contained in the following contract vehicles should be tailored to meet the requirements of the specific defense system program.

TMCR Attachment (1)

ADDENDUM SHEET

The descriptions below identify any deviations/waivers or additions to the requirements defined in the referenced TMCR paragraphs.

TMCR Paragraph No.	Description
4.1.a	The text and tabular material for the review manuscript copy shall be delivered in (add mutually agreeable word processor application software). The text and tabular material for the final manuscript copy shall be delivered in SGML-tagged ASCII in accordance with MIL-M-28001. Additional requirements are contained in Appendix A of the TMCR.
4.1.b	The review illustrations and drawings shall be delivered in a raster data file. Navy Image File Format (NIFF) shall be used for the raster data contained in a MIL-R-28002 raster data file. Additional requirements for raster data files are contained in SPAWAR-S-903. The final illustrations and drawings shall be delivered in IGES in accordance with MIL-D-28000.

FIGURE 14. Sample TMCR Addendum Sheet for Illustrated Text Data File Deliverables

NOTE: This addendum sheet was developed using Space and Naval Warfare Systems Command (SPAWAR) TM Contract Requirement (TMCR). Any specific paragraphs listed in this TMCR addendum sheet reference this document.

4.8 IETM Deliverables

The IETM deliverable option, described in 4.1.1.3, is the most dynamic and comprehensive data deliverable option available to the acquisition management team. It is of the utmost importance that the acquisition management team know the specific digital and management infrastructure and end user requirements when specifying this deliverable option due to the vast network of data resources associated with an IETM. The GCO is designed to assist the acquisition management team in gathering the necessary background information. Selected delivery media options, which may vary depending on the specific user's requirements (see figure 10), include: (1) Optical disk or CD-ROM, (2) Magnetic disk, or (3) 9-track magnetic tape, all in accordance with MIL-STD-1840.

NOTE: Paper TMs may be requested in addition to the IETM but only for verification of the digital data.

4.8.1 Cost

IETMs should be built on a solid foundation of basic logistics technical information (comprehensible, valid, appropriate task procedures; accurate configuration identification; etc.). Creating and maintaining such information for IETMs is a major cost. The technology to author, distribute, and use IETMs is a lesser, largely one-time cost. Cost analysis information was not available at the time of printing.

4.8.2 CDRLs

To invoke this data deliverable option, specific TMCRs and CDRLs must be developed to identify the type of TM required and include language that specifies exactly how data will be delivered under the contract including media, format (in this case a processable text data file), and content. To invoke this data deliverable option, specific CDRLs and TMCR addendum sheets are being developed as examples (not available at the time of printing). The information contained in the following contract vehicles should be tailored to meet the requirements of the specific defense system program.

4.9 Contractor Validation

The contractor should be required to validate that the delivered TM conforms to the contractual requirements. Specific validation agenda should be provided in the contractor's validation plan and associated documentation.

4.10 Government Verification

The acceptance of CALS digital data products, either delivered on physical media or by CITIS, is different in several ways from the acceptance of comparable paper data products. The following paragraphs provide details on the acceptance of digital data products and information services.

4.10.1 Digital Data Acceptance

The unique aspect of CALS digital data deliverables is that they will be subject to inspection and acceptance on several levels. The lowest level of acceptance is the data content and format. The acceptance process at this level is identical to acceptance of the data product provided on paper. This level of acceptance will be accomplished by viewing the data either through use of computer video screen or by viewing a paper printout of the data product.

The next level of acceptance is adherence to the specified CALS data exchange format. This will usually be compliant with the CALS standardization documents or other national or international data exchange standards. This level of acceptance may be aided by automated tools obtained, if available, from the CALS Test Network (CTN) or each service-component CALS office. The next level of acceptance is applied to the MIL-STD-1840 digital data format if it has been specified. Again, automated tools may be used to verify compliance. Other formatting requirements may be subject to inspection and acceptance including X12 EDI format, when specified.

Finally, the physical media may have acceptance criteria to be applied. This level of acceptance will not be used if data has been formally delivered by the CITIS. The

means of inspection to be used should be provided to the contractor as soon as these means have been determined. Any or all levels of acceptance may be performed at the contractor's facility or at the Government's facility, as required. In addition to digital data acceptance, CITIS requires additional acceptance requirements be applied.

4.10.2 CITIS Acceptance

Acceptance of the service and the CITIS Contractor Line Item Number (CLIN), if utilized, is a verification that the contractor has provided the service as specified. The CITIS functional requirements are defined by MIL-STD-974(Draft) and the particular statement of work. A checklist of CITIS functional requirements may be prepared to assist in tracking contractor compliance. These functional requirements may include service availability, maintenance response, provision for core information functions, provision for value-added information functions and the like.

Assurances of adequate acceptance testing for CITIS should be obtained via contractor demonstration of the service. The test should include demonstration of functional capabilities and verification that the CITIS will handle data required to be formally delivered through CITIS without alteration of the data product. Such a test is not required for each delivery but may be rerun if major maintenance has been accomplished or if sending or receiving systems have been changed enough to warrant an additional test. If specific test data are deemed necessary for adequate testing of a CITIS, that test data should be provided and results reviewed on-site at a customer facility. On-line access service should be accepted when it is demonstrated that a person with proper authorization can perform the contractually required core and value-added functions from a terminal or workstation at the customer's facility or as otherwise agreed.

Electronic data transfer service acceptance should occur when a single instance of transfer of the specified deliverable type can be achieved including successful download of data into the customer's system when contractually required. This data may be real product data or test data, as appropriate.

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

NAVY/MARINE CORPS MANAGER'S DESKTOP GUIDE FOR CALS IMPLEMENTATION

SECOND EDITION
30 JUNE 1993

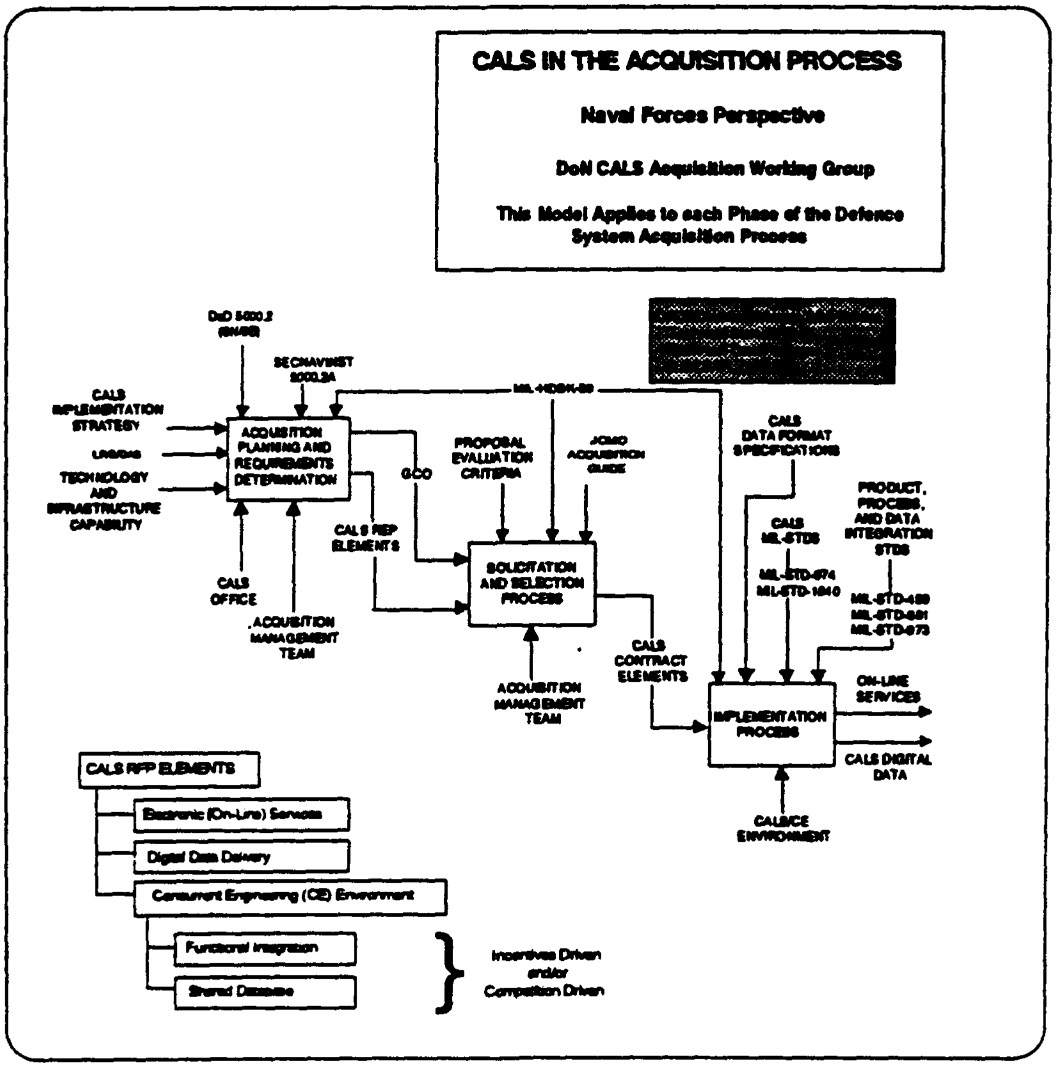
GUIDE CONTENTS

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

SECTION 8

Applying CALS To The Logistic Support Analysis Process



APPLYING CALS TO THE LOGISTIC SUPPORT ANALYSIS PROCESS

SECOND EDITION

30 June 1993

Prepared by:
CALS Resource and Implementation Cooperative (RIC)

Prepared for:
Naval Forces CALS Architecture and Environment

FOREWORD

Purpose

The Navy Computer-aided Acquisition and Logistic Support (CALS) Acquisition/Implementation Sub-Group has charged the CALS Resource and Implementation Cooperative (RIC) with developing acquisition guidance for each of the three process architectures defined in the Navy CALS Architecture/Implementation Plan. This document is the result of an exhaustive search and distillation of information pertinent to applying CALS to the creation, management, and use of Logistic Support Analysis (LSA) process and LSA data. The purpose of this document is to aid the Navy/Marine Corps Acquisition Managers, project engineers, and project logisticians in applying CALS to weapon system procurements within the LSA process.

Scope

The three process architectures described in the Naval Forces CALS Architecture and Environment are:

- Engineering Drawings
- Technical Manuals (TMs)
- Logistic Support Analysis Record (LSAR).

This document has been revised to clarify the LSA process and the use of LSA data. This document revision has also removed the appendix that contained CALS terminology, regulations, specifications, and handbooks. This information has been consolidated with similar information removed from Technical Data Package and Technical Manual documents and is provided as an appendix of the Desktop Guide.

Overview

Section 1.0, Introduction, provides a brief introduction to the purpose, scope, and background pertaining to CALS and the LSA process.

Section 2.0, LSA and LSAR Introduction, provides a brief overview of LSA and LSAR.

Section 3.0, Current Considerations, provides topics of consideration that must be addressed by the Acquisition Manager pertaining to the application of CALS initiatives to the LSA process.

Section 4.0, Future Considerations, addresses future trends and issues that will need to be taken into consideration when an Acquisition Manager seeks to apply CALS to the acquisition of LSA data.

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APPENDIXES

Appendix A: Acronyms, Definitions, and Applicable Documents
Appendix B: Product Data
Appendix C: Navy Infrastructure Modernization Program
& Other Navy CALS Initiatives

Appendixes A, B, and C as referenced in this document are contained in the back of the Desktop Guide.

FIGURES

1.0 INTRODUCTION

Computer-aided Acquisition and Logistics Support (CALS) is a Department of Defense (DoD) strategy that, when fully implemented, will enable more effective creation, exchange, and use of digital data to acquire and support weapons systems and equipment. Logistics Support Analysis (LSA) is a systematic and comprehensive analytical process that is conducted on an iterative basis through all life cycle phases of the system/equipment. LSA is for quantifying and measuring supportability objectives [supportability includes all elements of Integrated Logistics Support (ILS) as defined by the Department of Defense Instruction (DoDI) 5000.2 required to operate/maintain the system/equipment].

Depending on the level of tailoring, extensive amounts of documentation and data are required as an input to, and generated as a result of, the LSA process. The LSA process fits into the ILS process as LSA tasks are planned, initial front end analyses are performed, and LSA reports are generated (see figure 1). LSA documentation consists of all data resulting from the analysis tasks conducted as defined in MIL-STD-1388-1A and is intended to be the primary source of validated, integrated, design-related supportability data pertaining to an acquisition program. LSA documentation is developed and maintained as a result of design, support, and operational concept development and is updated to reflect changes. Changes can occur because of the availability of better information from testing, configuration changes, operational concept changes, and support concept changes during the acquisition process. Accumulated LSA documentation and data provide an audit trail of supportability and supportability-related design analyses and decisions. They are the basis for actions and ILS documents related to manpower and personnel requirements, training programs, provisioning, maintenance planning, resource allocation, funding decisions, and other logistic support resource requirements. LSA Record (LSAR) data is a subset of LSA documentation and is a structured means of aggregating LSA data. It is available for use by all services and ILS element functional areas. Because the LSAR database is structured, it has become the primary means of storing logistics data on digital media.

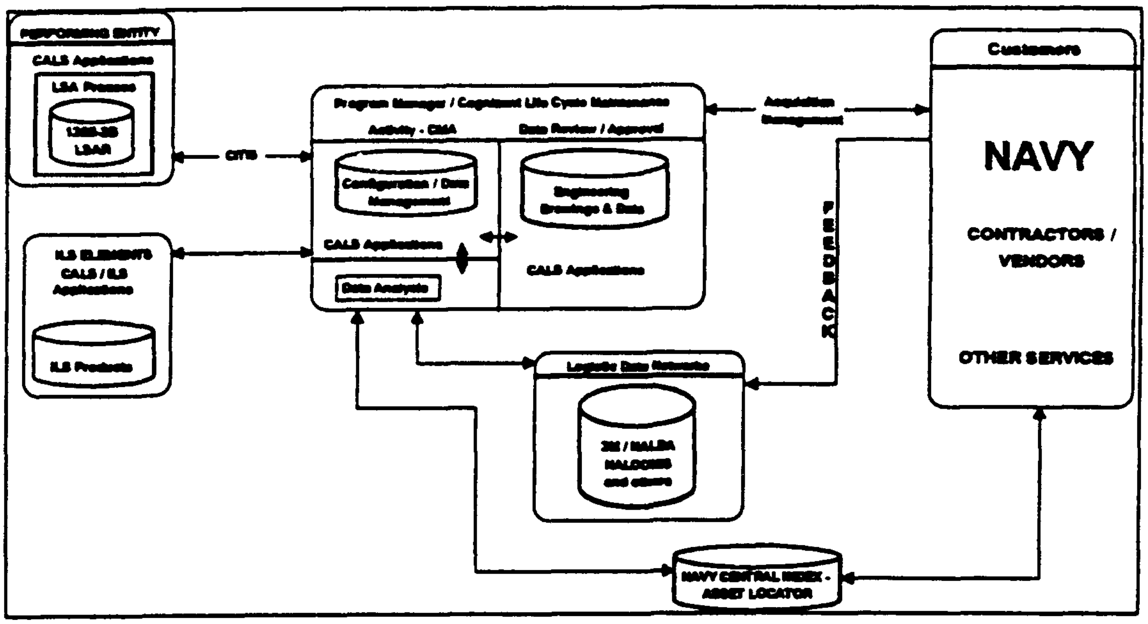

FIGURE 1. ILS Process Architecture

1.1 Scope

It is recognized that each defense system program is unique with individual constraints and access to a distinct set of infrastructure systems. This document is intended to provide the Navy/Marine Corps Acquisition Manager with an overview of Navy business practices for the creation, management, and use of LSA data in a CALS environment. Specific implementation of this process may be further tailored.

1.2 Purpose

The purpose of this document is to provide the planning for the creation, management, and use of LSA data, and the proliferation of this data through the ILS element functional areas. These areas need to take advantage of the capabilities provided by the automation and integration capabilities of information systems. This document will correlate and identify products and processes within, and related to, specific ILS functional element areas that either input data to, and/or receive data from, the LSA process. Digital conduits, those areas where LSA digital data can be directly linked to other processes or products, will be identified. Common data used where current digital linkage is not available will also be identified.

The intent of this document is to:

- Provide an overview of the CALS relationship to the LSA process and the development of LSA data
- Describe the origins of data used as input to the LSA process in a CALS environment
- Describe relationships between LSA data and various engineering systems and digital tools used within a CALS environment
- Describe the migration of LSA data to various ILS element functional areas and products through digital application

- Describe life cycle consideration relevant to LSA and CALS
- Describe future CALS modernization efforts and consideration.

1.3 CALS Introduction

The Department of Defense (DoD) CALS strategy is designed to actively promote the digital creation, management, and use of data in the acquisition and support of DoD systems. CALS is not a single system but rather a philosophy that emphasizes applications of standards and digital sharing of data. This includes the data generated by the LSA process. The electronic sharing of data allows the data to be created once and then used by multiple users, multiple times.

1.4 CALS and LSA by Functional Activity

Considerations that must be addressed when an Acquisition Manager is acquiring LSA data in digital format include: (1) Specifically who will use the data; (2) what hardware and software are needed to use it; (3) will the digital data be applied directly or as source information for the follow-on products; (4) are there digital data sources available that can be used as input to the LSA process if source data is available, who has it, what form is it in, and is there any problem associated with providing it? These considerations, to various degrees, must be addressed by the Acquisition Manager for and within each of the three major activities (create, manage, and use) associated with LSA data acquisition. Figure 2 illustrates some of these considerations.

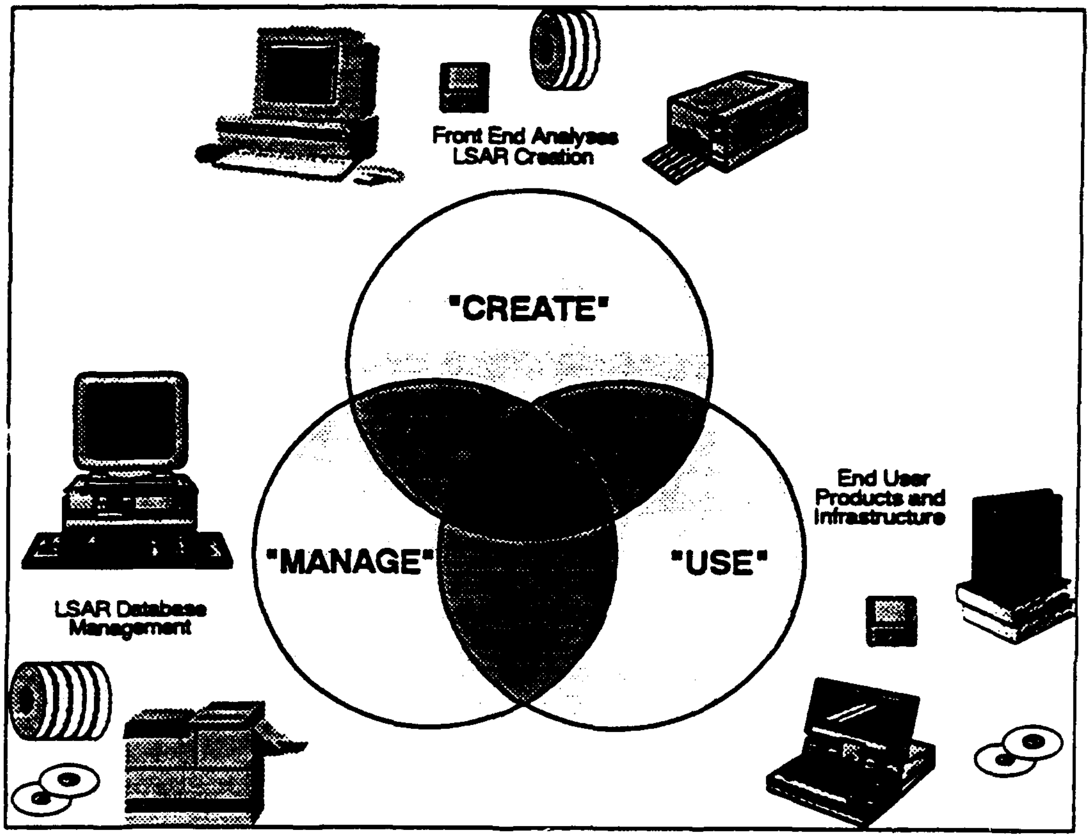

FIGURE 2. The Three Levels of Data Activity

In addition to activities during the acquisition phase of a program associated with the creation, management, and use of LSA data, the Acquisition Manager must also remain aware of follow-on Operational and Support (O&S) phase needs for, and uses of, LSA data. Figure 3 illustrates one of the prir⁻iples of Pareto's Law with regards to LSA data and life-cycle proportions. Though the acquisition phase makes up only a small portion of the program life cycle, a large share of LSA activity occurs during this period. Conversely, the amount of LSA activity during the O&S phase is considerably less when measured against the activity of the acquisition phase. The use of LSA data during the O&S phase is applied over a longer period of time. The Acquisition Manager should ensure that the LSA process not only impacts and records the design of the product, but also is transferable to the agencies and activities that will ultimately support the design during the O&S phase.

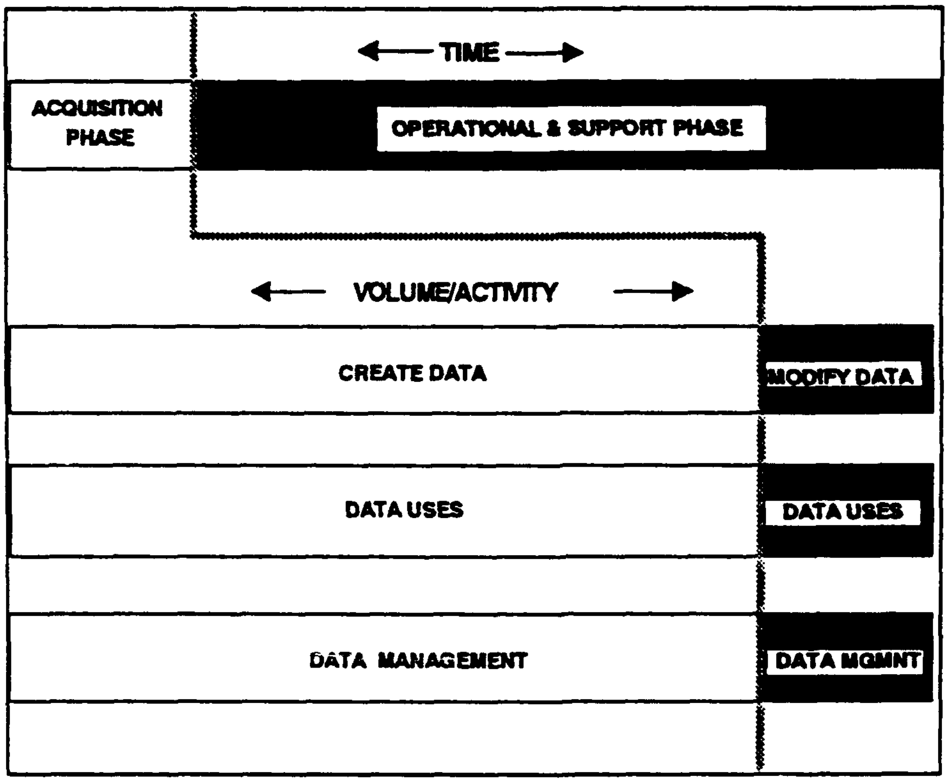

FIGURE 3. LSA Data and Activity Comparison by Phase

1.4.1 LSA Data Creation Activities

The first level of activity during the acquisition phase of a program is the creation of the data. The Acquisition Manager is the primary focal point during the creation phase. Of utmost concern to the Acquisition Manager is the assurance that the data is developed once and then used many times. The ability to review and/or access LSA data by all areas involved in the design process ensures early identification and quantification of support systems requirements as well as the best design for supportabilty. The Acquisition Manager must ensure that the internal contractor product development team members, as well as Government reviewing agencies, have access to current and relevant LSA data.

The ability to access and review digital data is driven by the availability of appropriate software and hardware. The Acquisition Manager should ensure all functional areas are queried for software and hardware availability prior to contract placement. Of equal importance, the Acquisition Manager should ensure that support activities are aware of LSA data access, review and approval methodologies, and the roles and responsibilities each activity will play.

1.4.2 Follow-on LSA Data Modification Considerations

In addition to concerns associated with the creation of LSA data, the Acquisition Manager should consider future requirements to modify the data by organic Government activities. It is of particular importance to ensure that all Front End Analyses studies and reports, as well as the LSAR database, are provided to the depot or support activity in a usable format. By doing this, the depot and/or support activity will be provided not only with the LSAR database that supports the design, but also with the analyses and studies used to arrive at the design.

1.4.3 LSA Data Management

The second level of activity is associated with the management of LSA data during both the acquisition and O&S phases. The Acquisition Manager must consider the specific Navy/Marine Corps infrastructure program that will manage and store the digital data during both phases. The data delivered must be compatible with the existing digital Navy/Marine Corps system in place or being developed. If changes to the digital Navy/Marine Corps infrastructure systems are required, they must be fully justified and coordinated with the personnel responsible for the configuration control of LSA data. During the O&S phase, the LSA data is typically assigned to a support activity such as a Depot Cognizant Field Activity or organic Navy/Marine Corps Data Repository. Of primary importance here would be making data available to potential users and maintaining configuration control.

1.4.4 LSA Data Uses During the Acquisition Process

The final level of activity is associated with the use of LSA data. During the Acquisition Process, LSA data is typically used in three ways. First, the MIL-STD-1388-1A Front End Analysis 200 and 300 series tasks are used to influence and provide a basis for the design of the system (both the hardware and the support elements required for deployment and use). Secondly, the LSAR database is used to document the system's configuration and maintenance/ support requirements and procedures. Finally, the LSAR database is used as a cornerstone for the developing ILS element products that include provisioning data, technical manuals, training data, support equipment data, etc.

Paramount to ILS product development is the timely access to current and accurate LSA data. The following are just a few of the considerations the Acquisition Manager should make when contracting for LSA data.

- Technical Manuals (TMs): The LSAR maintenance tasks (LSA-401) should be used as a basis for, and/or a direct input to the system's TM(s). The Acquisition Manager should ensure that the development of the TM(s) and the detailed LSA

task analysis are orchestrated in such a manner as to eliminate duplicate efforts. One potential problem, which somewhat limits the effectiveness of authoring the TM within the confines of the LSAR database, is the Standard Generalized Markup Language (SGML) tagging requirements necessary for CALS-compliant TMs. Several approaches including embedding the SGML tags within the LSAR database itself or "filtering" the text as it is imported into the TM author/editing environment offer potential solutions.

- Training Data: The training functional area takes information from the LSAR database and uses it as source data to develop the Navy Training Plan (NTP) and various other training products. An important CALS-related consideration would be to provide the training-related LSA source data to the training area in a usable digital format.

- Provisioning: Supply support and initial provisioning efforts take direct advantage of the data contained within the LSAR database. The Acquisition Manager should coordinate the availability of the LSAR database with provisioning efforts.

- Support Equipment (SE): Support Equipment Recommendation Data (SERD) information is typically generated during the LSA process and documented within the LSAR database. The Acquisition Manager should coordinate LSAR access and delivery with SE Logistics Element Manager (LEM).

1.4.5 LSA Data Uses During the O&S Phase

A major concern to the Acquisition Manager is the usefulness of the LSA data during the O&S phase of a program. The Acquisition Manager should ensure that both LSA Front End Analysis data and the LSAR database are made available and/or maintained by the support activity for both configuration control and evaluation of potential Engineering Change Proposals (ECP) during the O&S phase.

One additional area of consideration concerns the end users. The end users perform an important feedback function in the LSA process. Knowledge of actual usage of the data when fed back into the LSA process is invaluable in correcting design and support system deficiencies. The Acquisition Manager must not overlook this vital source of data and should consider the end users when acquiring digital data and feedback methodologies.

In conclusion, the Acquisition Manager must include in the decision making the hardware and software that exists at all user sites being considered. It is counterproductive to generate and make available to the end users digital data that they do not have the capability of using. The Acquisition Manager cannot assume the systems exist and will be used. The specific environment must be determined.

1.5 CALS-Related Questions

Questions that must be asked and answered include:

- What systems are available in the field and at support activities?
- How is the data to be used by the field/support activities?

- For specific users, what data media and formats are compatible with what they already have or are planning to acquire?
- How will they acquire the new equipment and software needed if existing systems are inadequate?
- How will these new systems be supported?

The answers to these and similar questions will provide a comprehensive plan for implementing and using the digital data that is acquired. The answers are dependent on the individual users in the specific acquisition program.

2.0 LSA AND LSAR INTRODUCTION

The Integrated Logistics Support (ILS) goal is an organized, planned effort that provides for support and maintenance considerations that influence the design of systems acquired by the DoD. The planning of the ILS effort is key in fitting all of the logistic support elements together in a timely manner. The LSA process ties the ILS efforts together following the full life cycle of the end item (figure 4).

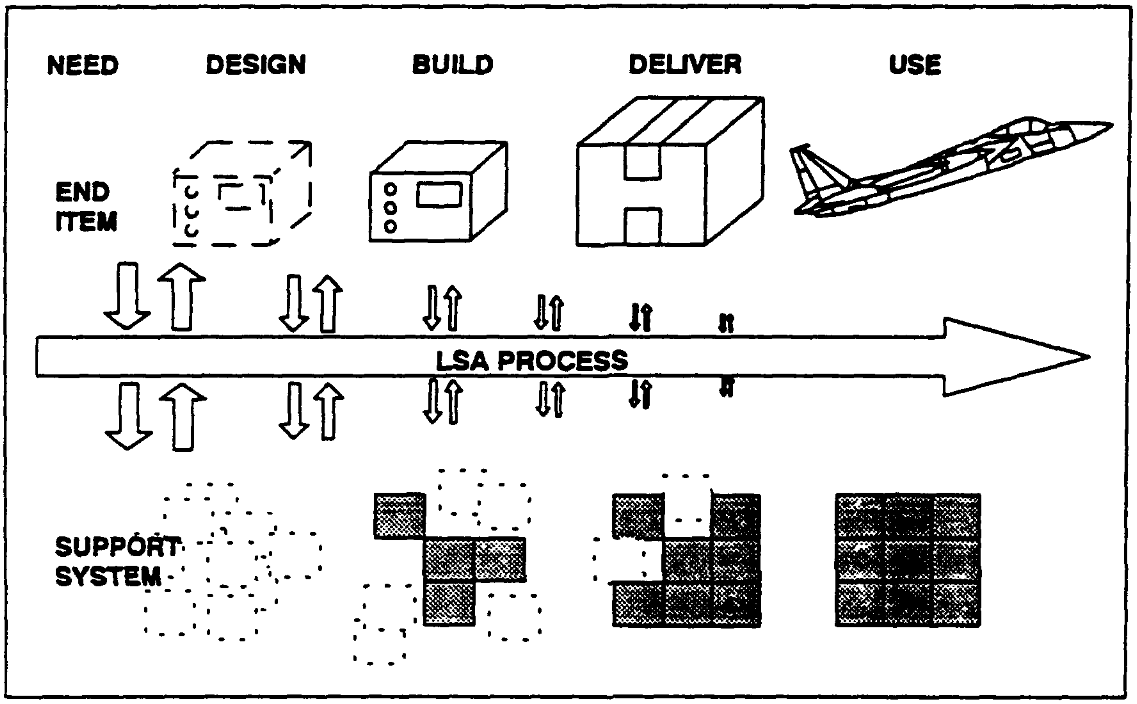

FIGURE 4. ILS and LSA Planning Process

The LSA process is a planned series of tasks performed to examine all elements of a proposed system to determine the logistic support required to keep that system usable for its intended purpose and to influence the design so that both the system and support can be provided at an affordable cost. The LSAR is a subset of LSA data that resides in an approved format in an approved database system (figure 5).

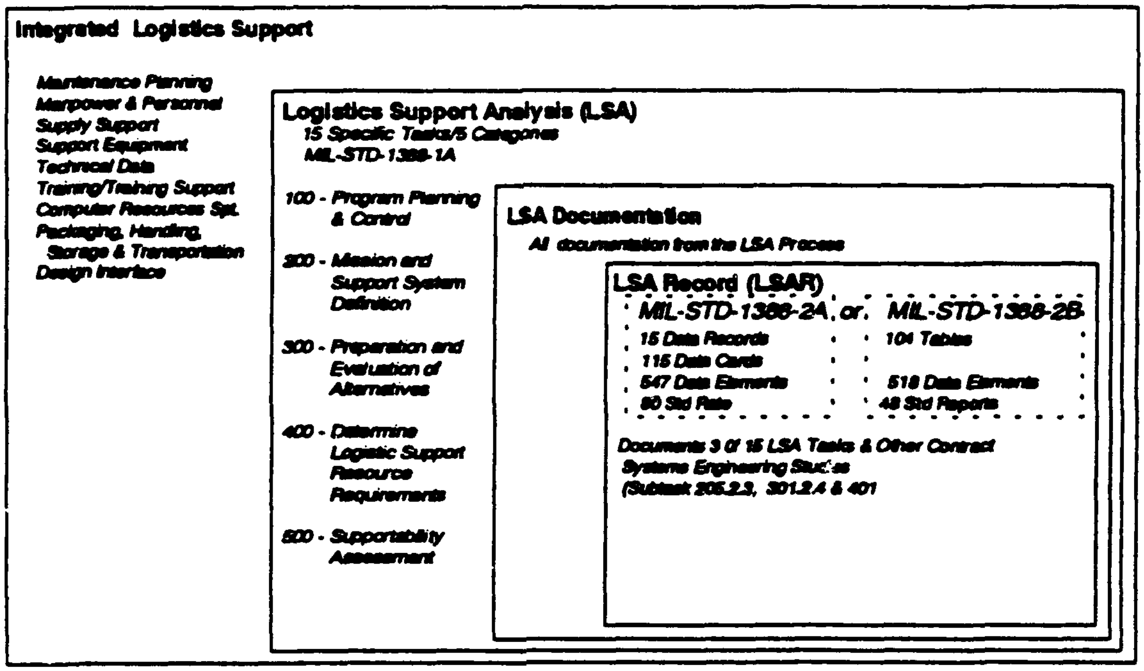

FIGURE 5. ILS/LSA/LSAR Relationship

ILS data may be presented in any form or characteristic including, but not limited to, hard copy, audio/visual displays, magnetic tape, disc, and other electronic media. ILS data normally consists of plans, reports and analyses performed in support of development, deployment, and support of a specific defense system. ILS data will be created in a processable data format consisting primarily of text.

An ILS program interfaces with and produces processable data related to:

- Maintenance Planning
- Manpower and Personnel
- Supply Support
- Support Equipment
- Technical Data
- Training and Training Support
- Computer Resources Support
- Facilities
- Packaging, Handling, Storage, and Transportation
- Design Interface

2.1 LSA Summary

LSA documentation, including data in the LSAR database, is generated as a result of the analysis tasks specified in MIL-STD-1388-1A. As such, the LSAR database (created as a processable database) shall serve as the center of the ILS technical support database, which can interface with material acquisition programs to satisfy the support acquisition. The specific data entry media, storage, and maintenance procedures are left to the performing activity.

2.2 LSAR Summary

MIL-STD-1388-2A/2B, "DoD Requirements for a Logistic Support Analysis Record" (LSAR), contains general requirements and defines the data elements, data record/table formats, output report formats and guidance for tailoring the LSAR to a particular application. Simply put, the LSAR is that portion of the LSA documentation consisting of the detailed data pertaining to the identification of Logistics Support requirements of a system or equipment. MIL-STD-1388-2A/2B is nothing more than the database where a portion of the LSA documentation is stored. The LSAR is not an end product but is intended to be used and updated throughout the acquisition life cycle of the system or equipment.

MIL-STD-1388-2A was superseded by MIL-STD-1388-2B in March of 1991. MIL-STD-1388-2A is mentioned because there are many programs currently in effect that are required to deliver data in the MIL-STD-1388-2A format. MIL-STD-1388-2B replaces the Hollerith 80-column card approach of -2A with an integrated database employing current industry-developed relational database technology.

Although many of the data elements are the same in 2A and 2B, many are different. To go from to 2A to 2B is not a simple task. The transfer of data from the flat file 2A database to the relational tables of the 2B database is not a transparent upgrade of LSAR database software. If an item is being modified and an LSAR database already exists as a 2A database, the Acquisition Manager should consider the benefits gained when going to a 2B database. If the benefits are minimal, modify the 2A database. A new acquisition program should use the MIL-STD-1388-2B LSAR database. Validated LSAR Automated Data Processing (ADP) systems are available for automated storage of the LSA data. A list of these LSAR ADP systems may be obtained from the USAMC Material Readiness Support Activity (MRSA), ATTN: AMXMD-EL, Lexington, KY 40511-5101. The following two subsections discuss the two versions of LSAR databases in more detail.

2.2.1 MIL-STD-1388-2A Summary

MIL-STD-1388-2A prescribes the data-element definitions, data-field lengths, and data-entry requirements for the LSAR database. It identifies the reports that are generated from the LSAR database and identifies the input formats for the Joint Service LSAR ADP system when it is used. This standard applies to all system/equipment acquisition programs, major modification programs, and applicable research and development projects through all phases of the system/equipment life cycle. The logistic support analysis process is conducted on an iterative basis through all phases of the system/equipment life cycle to satisfy the support analysis objectives. During the acquisition phase, the contractor would normally perform the LSA process. After the transition to the organic support phase, the Navy/Marine Corps would continue the LSA process. Similarly, LSA data are generated in all phases of the system/equipment life cycle and is used as input to follow-on analyses and as an aid in developing logistics products. LSA data and documentation are generated as a result of MIL-STD-1388-1A. As such, the LSAR database shall serve as the integrated logistic support technical database applicable to all material acquisitions programs to satisfy the acquisition of support resources. The specific data entry media, storage, and maintenance procedures are left to the performing activity.

2.2.2 MIL-STD-1388-2B Summary

MIL-STD-1388-2B contains 10 relational table areas, which are further divided into 104 individual data tables. The new MIL-STD-1388-2B will satisfy a wider range of logistic product requirements and promote the use of relational database management systems for LSAR automated data processing (ADP) systems. Just like MIL-STD-1388-2A, MIL-STD-1388-2B provides information pertaining to technical characteristics of a system or equipment and provides data directly related to the supportability of that system or equipment.

MIL-STD-1388-2B Appendix A provides guidance for fulfilling the requirements of a relational database system. Although each relational table is independent and equal, data integrity rules will dictate that a row of information be established in a table from which foreign keys originate prior to establishment of the lower-tiered data table. The interrelationships and data hierarchy among tables are established only through common data element keys and data values. MIL-STD-1388-2B provides the media options of the LSAR relational tables being delivered. This provides the capability to subsequently produce any of the LSA reports, other data files, and ad hoc reports via the query capability of a validated LSA relational ADP system.

3.0 CURRENT CONSIDERATIONS FOR THE LSA PROCESS IN A CALS ENVIRONMENT

System acquisition and ILS policies are contained in DoDI 5000.2. The four prime factors that govern system acquisition programs are cost, schedule, performance, and supportability. The LSA process provides direct input into the supportability and cost factors associated with a system/equipment and, therefore, provides significant input into system/equipment decisions. The CALS environment offers the opportunity through digital application of the LSA process for reductions in Life Cycle Cost (LCC). The ability to create data once (including LSA, engineering, and ILS data) and use it many times impacts the cost of the LSA process and the follow-on support costs. If the LSA data and associated analysis (FMECA, RCM, etc.) is created in a digital format, then digital data required for the LSA can be linked and fed to the LSAR database in an automated fashion. The initially created LSA data is then available for use in all technical data products. The Acquisition Manager must consider the digital format, media, HW/SW issues, required framework, architecture, and infrastructure when making LSA process decisions in the procurement phase (figure 6).

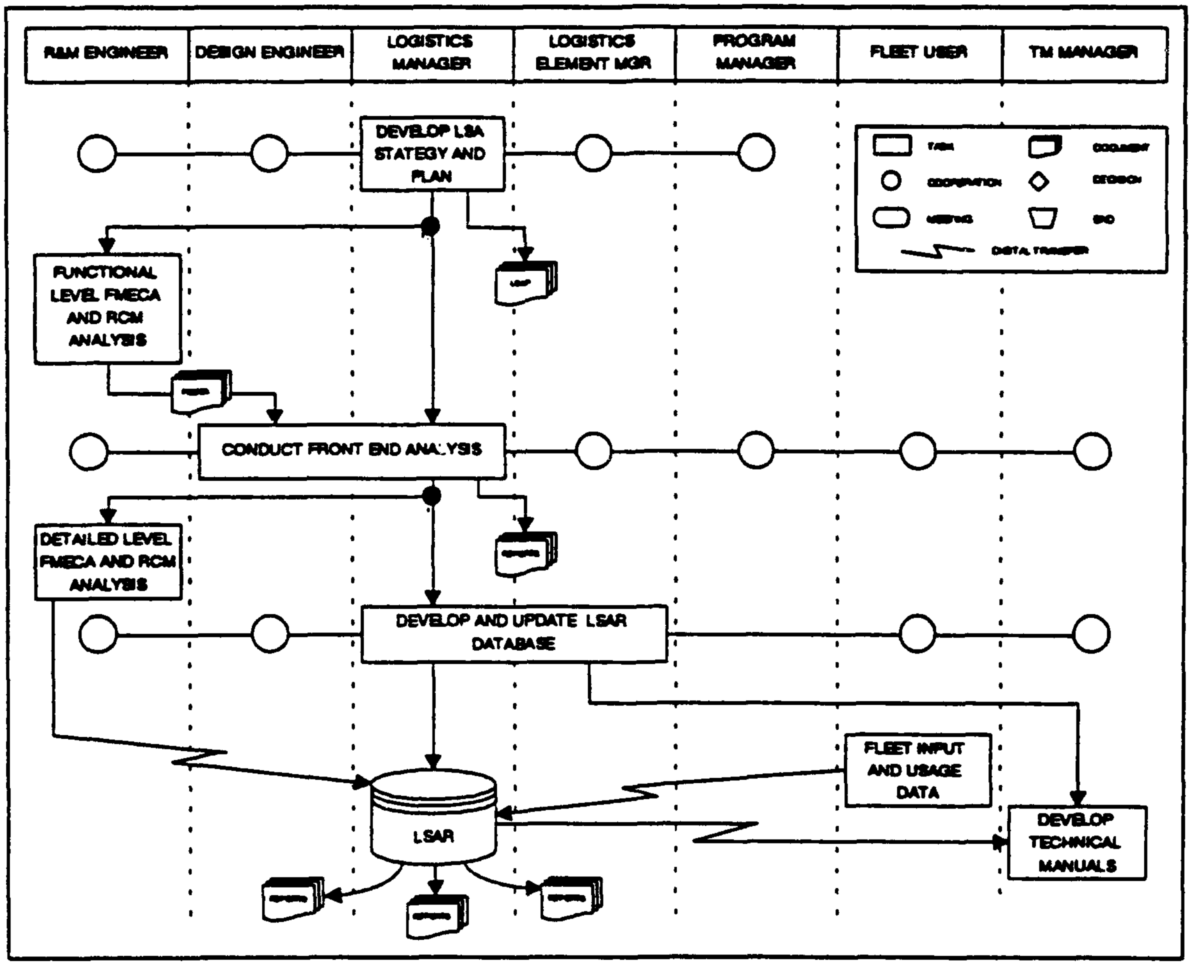

FIGURE 6. CALS and the LSA Process

As an alternative, the Acquisition Manager could place the responsibility for digital data considerations on the contractor in the Request for Quotes/Request for Proposals

(RFQ/RFP). MIL-STD-1388-2B is required for all new procurements. Also, the instructions to offerers could indicate that the digital application of LSA data will be weighted strongly in the evaluation of the offerers" CALS Implementation Plans (CALSIPs).

3.1 Populating the LSA Database

3.1.1 Potential Sources of LSA Data

The digital application of data must start with the onset of the LSA process. Acquisition Managers should begin by providing Government Furnished Information (GFI), including the LSA strategy and ILS planning information, in digital form to the contractor. Digitizing these products will help reinforce the Government commitment to CALS, as well as reduce costs and improve communications. Figure 7 represents potential sources and the flow of information into the LSA process.

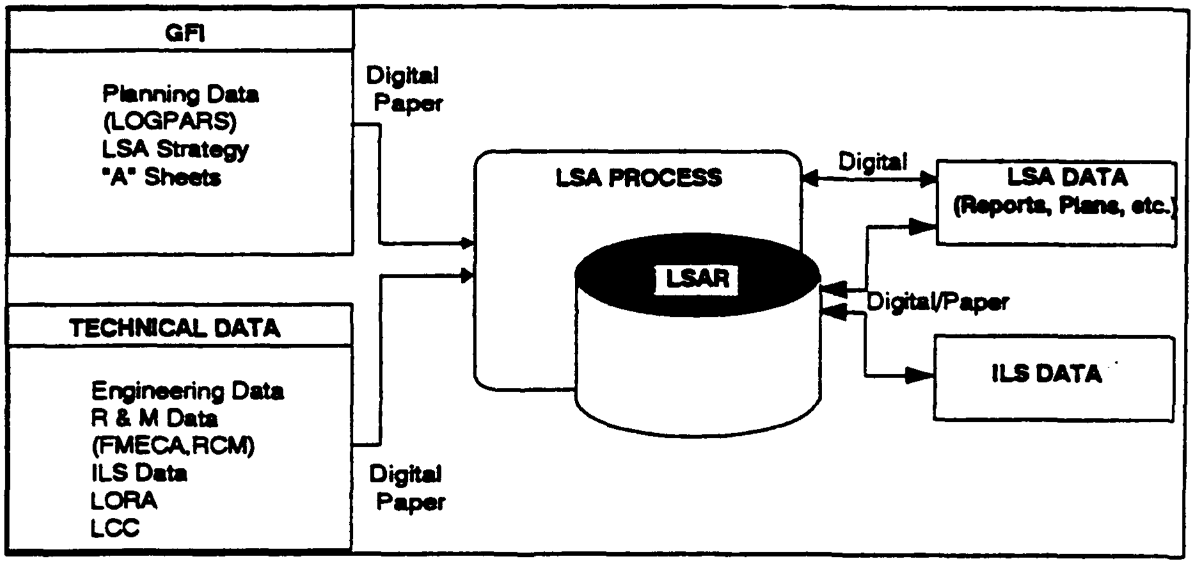

FIGURE 7. Data Flow of the LSA Process

Populating the LSAR database can be aided by a well defined LSA Plan (LSAP). The Acquisition Manager should require that this plan define not only who in the Contractor's organization is responsible for generating and receiving LSA source data, but also in what form the data should be developed, and how the Contractor plans to import this data into the LSAR database. Populating the LSAR database would be simplified if the LSA data existed in a digital format and data needed could be easily extracted for input. The amount of preparation and maintenance of the LSAR database is directly related to the complexity of the hardware and software end item design.

3.2 Managing/Maintaining LSA Data

The Acquisition Manager will decide whether the weapon system's data will be maintained under a Contractor Integrated Technical Information Service (CITIS) arrangement or other digital means of delivery to the Government. In either event, the decision process in determining the LSA data required will be the same.

Considerations must be made that encompass all life-cycle phases from design to disposal. The Acquisition Manager must be aware of the infrastructure systems available that will be impacted and possibly use the LSA digital data created. The Acquisition Manager must keep abreast of Navy/Marine Corps programs that may create and/or use LSA data such as Joint Engineering Data Management and Information Control System (JEDMICS), Ship Configuration and Logistic Support Information Service (SCLSIS), Computer-Aided Design (Second Acquisition) (CAD-2), etc.

3.3 Using LSA Data in the CALS Environment

This section will focus on the current capabilities of CALS to employ and use the data that exists in the LSA database. Distinctions between MIL-STD-1388-2A and MIL-STD-1388-2B will be discussed only where relevant to digital data interaction. Emphasis will be placed on creating the data once and using it many times. The unique effects of a shared digital environment on the current use of the LSAR database will be investigated and discussed.

3.3.1 CALS Effects on LSAR Report Requirements

In the past, the completeness and accuracy of the data has typically been verified by the contractor demonstrating the ability to produce various output reports from the LSAR database. The Acquisition Manager is encouraged to shift emphasis from the delivery of the LSA reports to the delivery of, and/or preferably the access to, the LSAR database itself. In doing this, the verification of the database and its accuracy and completeness can be more easily and accurately assessed. However, prior to using this approach, the Acquisition Manager must ensure that HW/SW is in place to accept, process, and validate the LSA data.

3.3.2 Interaction of LSA Data with Concurrent Engineering/Integrated Design

The LSA process is iterative in nature. The LSAR database provides a structured, standardized, yet flexible/tailorable approach to the documentation of the data that results from accomplishing various LSA tasks. As such, the LSA process is an effective tool to aid in the application of concurrent engineering initiatives. To be effective, LSA documentation must be initiated early in the acquisition life cycle, must be updated to reflect changes in the hardware design and support concept, and must be tailored to be commensurate with individual program requirements, constraints, and characteristics. This is consistent with concurrent engineering/integrated design as all life-cycle support considerations are being considered at each phase of the development process.

3.3.3 Specific CALS Considerations Affecting Data Acquisition

During the analysis of the supportability portion of the LSA process, LSA data is used as direct input into the development of data products associated with ILS elements such as provisioning lists, personnel and training requirements, and TMs. This assures compatibility among ILS element documents and permits common use of data that apply to more than one logistic element. The CALS infrastructure available to the Acquisition Manager when he is ready to issue an RFQ/RFP must be considered. Delivery of the LSA/LSAR data/database may be via digital media (magnetic or optical

media) or must be made available under a CITIS requirement. The media selected will be driven by factors including infrastructure and data access needs.

3.3.4 Migration of LSA Data Into ILS Element Products

For the proper migration of LSA data to be complete and full support of all ILS element products, the concurrent engineering concept must also be implemented. The Acquisition Manager must task the contractor to support the movement of LSA data into the design process through the use of ILS element products. The LSA process and LSA data captured must take into account the function of the system under design. The LSA data and resulting LSAR database must support and be used as input data to various ILS elements including the NTP, support equipment, facilities, supply support, manpower and personnel lists, environmental impact, parts control, and so on. It is essential that coordination and interfacing of engineering disciplines and ILS functional elements be effected to maximize the usage of data developed by each program element, thereby, realizing analysis economics and avoiding the generation of incompatible ILS products. Again, we want to create the data once and use it multiple times. Figure 8 depicts the migration of LSA data into the ILS element products.

It is important to identify the engineering and ILS functional element requirements that interface with the LSA process and generate LSA data. Results of analyses from other program elements can be used as source data for LSA tasks and vice versa. Inputs from the design, reliability and maintainability, human engineering, safety, LCC, and other program elements are generally required to satisfy the requirements of MIL-STD-1388-1A. Benefits of effective interfacing and coordination may also be achieved by utilizing the features of the LSAR database to record, store, and manipulate data in support of requirements levied by other program elements.

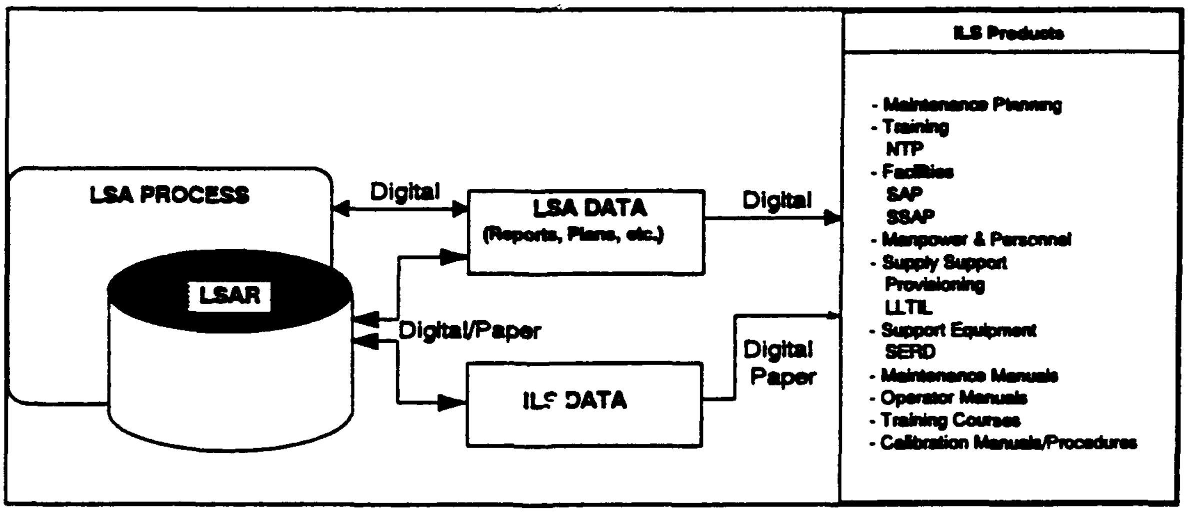

FIGURE 8. Migration of LSA Data Into ILS Elements

3.4 CALS Effects on Systems & Support Systems Designs

Weapon systems acquisitions are directed toward achieving the best balance among cost, schedule, performance, and supportability. There is increasing awareness that supportability factors such as manpower and personnel skills are a critical element in system effectiveness. This awareness has necessitated early support analyses and

the establishment of system constraints and design goals. The awareness has necessitated the pursuit of design, operational, and support approaches that optimize life-cycle costs and the resources required to operate and maintain systems. The Acquisition Manager should encourage the use of Navy/Marine Corps CALS infrastructure modernization programs such as Advance Technical Information Support/Interactive Electronic Technical Manuals (ATIS/IETM) to enhance the supportability factors of systems and support system designs. Both cost and performance may be improved using digital application of technical information.

3.5 Sample CALS & LSA Tasks Statement of Work

When requesting MIL-STD-1388-1A LSA tasks in an RFQ/RFP Statement of Work (SOW), specific requests for CALS should be included. During the tailoring process of LSA tasks, the Acquisition Manager should request the contractor to include the impact of CALS when performing the task.

3.5.1 MIL-STD-1388-1A 100 Series Tasks

The primary purpose of the 100 Series LSA tasks of MIL-STD-1388-1A is the management and control of the LSA program. The Acquisition Manager should include CALS as a factor when performing Task 101, Development of an Early Logistics Support Analysis Strategy, when deciding which of the LSA tasks and subtasks will provide the Government with the best return on investment. The following statement may be included in the SOW when requesting a contractor to perform Task 102 of MIL-STD-1388-1A:

> "The contractor shall include as part of Task 102, Logistics Support Analysis Plan, a description of how CALS (the digital management and flow of data) is being integrated into the LSA tasks and shall identify how CALS will be used in interfacing the data developed from the LSA process with other ILS and system-oriented tasks and data."

3.5.2 MIL-STD-1388-1A 200 Series Tasks

The 200 Series LSA tasks of MIL-STD-1388-1A are to establish supportability objectives and supportability-related design goals, thresholds and constraints through comparison with existing systems and analyses of supportability, cost, and readiness drivers. CALS should be included as part of the objectives, considerations, and comparisons. The following statements may be included in the SOW when requesting a contractor to perform one of the 200 Series LSA tasks of MIL-STD-1388-1A in which CALS should be considered:

> "The contractor shall perform Task 201, Use Study, to identify and document the pertinent supportability factors related to the intended use of the (name of new system or equipment). This study shall include the contractor's intended use of CALS as one of the pertinent supportability factors."

> "The contractor shall perform Task 202, Mission Hardware, Software, and Support Standardization, to provide supportability and supportability-related design constraints for the (name of new system or equipment) based on existing and planned logistic support resources that have benefits due to cost,

manpower, personnel, readiness, or support policy considerations and benefits. Identification of existing and planned logistics support resources shall include CALS as one of the potential benefit factors to be considered."

"The contractor shall perform Task 203, Comparative Analysis, to select or develop a Baseline Comparison System (BCS) representing characteristics of the (name of new system or equipment). This analysis shall include any past CALS implementation of the design and support of the existing system. The analysis may be a factor in which judgments can be made in determining the feasibility of the supportability parameters. This analysis shall also include the identification of areas for improvement in which CALS may be targeted."

"The contractor shall perform Task 204, Technological Opportunities, to identify and evaluate design opportunities for improvement of supportability characteristics and requirements of the (name of new system or equipment). These opportunities shall consider implementation of CALS into the design objectives and techniques. The identity of CALS implementation in design improvements to logistic elements during development should also be considered."

3.5.3 MIL-STD-1388-1A 300 Series Tasks

The 300 Series LSA tasks of MIL-STD-1388-1A are to optimize the support system for the new item and to develop a system that achieves the best balance among cost, schedule, performance, and supportability. CALS should be considered as part of the functional requirements and/or a support system alternative. The following statements may be included in the SOW when requesting a contractor to perform one of the 300 Series LSA tasks of MIL-STD-1388-1A.

"The contractor shall perform Task 301, Functional Requirements Identification, to identify the operations, maintenance, and support functions that must be performed in the intended environment for each (name of new system or equipment) alternative under consideration. The identification shall include the contractor's intended use of CALS as one of these functional requirements."

"The contractor shall perform Task 302, Support System Alternatives, to establish viable support system alternatives for the (name of new system or equipment). The contractor shall include support concepts that foster CALS utilization when developing alternatives to the system level support concept."

"The contractor shall perform Task 303, Evaluation of Alternatives and Tradeoff Analysis, to determine the preferred support system alternative(s) for each (name of new system or equipment) alternative. For each evaluation and tradeoff to be conducted under this task, the contractor shall include the utilization of the intent of CALS as one of the criteria of evaluation."

4.0 FUTURE CONSIDERATIONS FOR THE LSA PROCESS IN A CALS ENVIRONMENT

While section 3.0 presents practical observations about the current effects of CALS on the acquisition of LSA data, this section will present some thoughts on where CALS is headed and how that might affect data use in the future. The influence of infrastructure developments in the Navy, within the DoD, and even in the international community will all affect the potential environment in which the LSA data acquired now may have to be used in the future.

4.1 Integrated Weapon Systems Database (IWSDB)

4.1.1 Future Trends

Future trends must lead to and support the fundamental objective of CALS, which is to lower costs to the Government, improve quality, and shorten lead times. The electronic sharing of data allows it to be created once and then used by multiple users, multiple times. The integration of functional processes will start with the integration of data. The acquisition strategy must specifically address the automation and integration of technical information systems and functional processes.

4.1.2 Effects on LSA Data and LSAR Databases

The process for determining LSA data and LSAR database requirements is an extension of the process currently used for determining data requirements, selecting appropriate data items, and developing the Contract Data Requirements List (CDRL) that identifies the requirements. The LSA/LSAR databases are the building blocks that are necessary to support an IWSDB. The process for determining LSA data and LSAR database requirements may evolve as the requirement for access to the data intensifies. There is significant potential for reduction of data requirements in that, with query capability, the Government can generate data, reports, and products on demand rather than having the contractor prepare and deliver them. As digital data utilization evolves, the media on which the data is delivered will also evolve as depicted on figure 9.

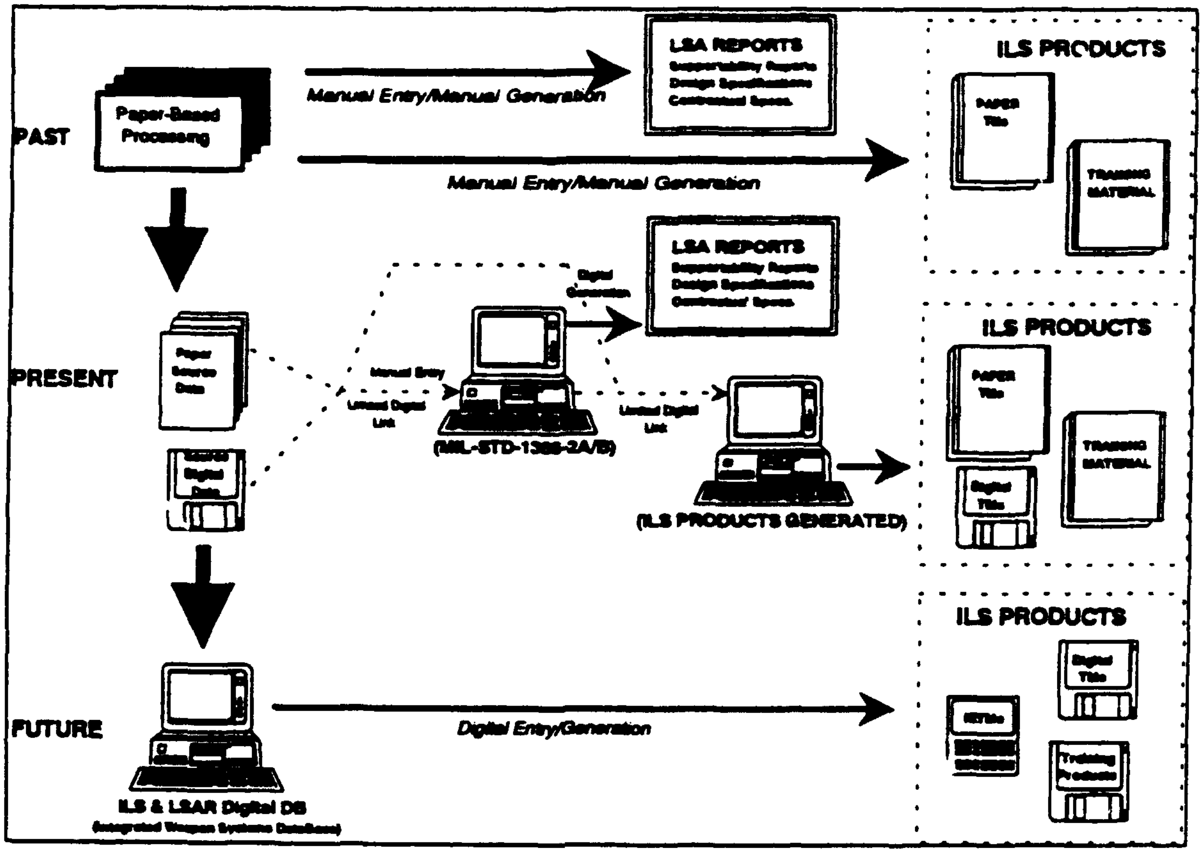

FIGURE 9. IWSDB Future Influence on ILS Data

4.2 Contractor Integrated Technical Information Service (CITIS)

4.2.1 Future Trends

Access to digital data will become the standard by which all acquisitions will be measured. Because CITIS provides access to contractor-managed, functionally-integrated information, it must play a significant role in improved Government operations and the streamlining of processes. An effective CITIS program will require foresight and added coordination efforts on the part of contractors, Government sponsors, and potential CITIS users. Functional integration approaches, as well as CITIS performance, must be considered. Measures should be developed to motivate contractors with top-level commitments to produce overall, functional integration and an effective CITIS implementation.

4.2.2 Effects on LSA

An effective LSA program will be planned, integrated, developed, and conducted in conjunction with the requirements of the overall acquisition program objectives. The LSA process will be established consistent with the type and phase of the acquisition program. To maximize the use of the plans, procedures, front-end analyses and reports developed from selected LSA tasks, it is necessary to establish a viable communication link with the contractor. Providing an early-on CITIS capability

(including the front-end analyses and documentation generated from the 200 & 300 series tasks of MIL-STD-1388-1A) will enhance the LSA process and the overall design effort.

4.2.3 Effects on LSA Databases

There are several considerations facing contractors when they are tasked with providing CITIS to support LSA databases. Areas of consideration include the following.

- Type of DBMS or languages: The number and disparity among database management systems, programming languages, data models, data descriptions or data organizations, and interface and access languages;

- Data element format: The number of discrete techniques for reformatting data to be presented to the user in a predefined, standard format including conversion of units of measure, translation into standard format, and other agreed upon translations or conversions;

- Source or location of data and applications: The user must know the differences concerning location, hardware, operation system, programming language, and access methods for specific systems;

- Relationship and dependencies: The degree to which the user must keep track of data relationships and dependencies within and across integrated data sets;

- Version knowledge and control: The degree to which the user must ensure that data retrieved from more than one system and database are consistent in terms of data values, version or status, and context.

5.0 SUMMARY AND CONCLUSIONS

As stated in the introduction to this document, CALS is a DoD strategy that will enable more effective creation, exchange, and utilization of digital data. The underlying purpose of this strategy is to move from a paper-intensive environment to a digital environment in an effort to reduce weapon-system acquisition time, support costs, and improve both data and product quality. Given the current state of the DoD budget and the likelihood that DoD dollars will continue to shrink in the foreseeable future, it is even more imperative that Acquisition Managers maximize the use of CALS as a springboard to reduced acquisition and downstream O&S costs.

The efficient utilization of the LSA process during a system's early life cycle (design and early development) is the cornerstone to reducing the overall system O&S costs. But in addition to simply applying the LSA process during a design phase, the Acquisition Managers must implement an effective and logical approach to the overall acquisition and management of all data including data associated with LSA, ILS, and engineering and program management through the entire life cycle of a system. It is no longer acceptable to procure and reproduce data when, in fact, the only difference is the format. Significant cost savings can be realized by both buying and utilizing previously procured data in a logical and controlled manner. The implementation of a CALS strategy will allow the Acquisition Manager to provide the foundation to electronically share the data that is developed from his/her program with multiple users, multiple times. Future CALS-related modernization efforts, including those presently underway, will help improve and consolidate both data acquisition and data management. But, until these efforts are completed, it is the individual Acquisition Manager's responsibility to apply CALS to the maximum benefit of both his/her program and the Naval Forces in general.

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

NAVY/MARINE CORPS MANAGER'S DESKTOP GUIDE FOR CALS IMPLEMENTATION

SECOND EDITION
30 JUNE 1993

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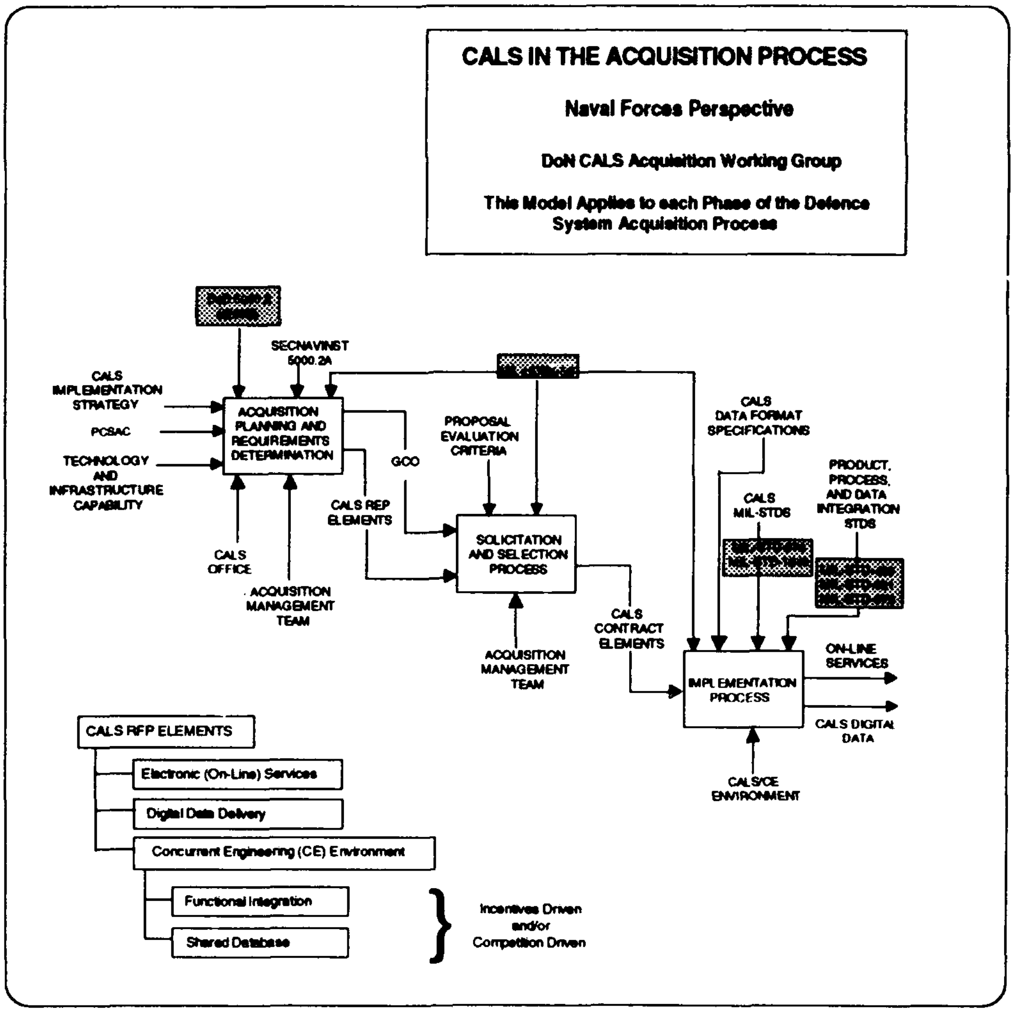
CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

SECTION 9

CALS Standards Overview



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Communications & Information Systems Department

Research and Development Report

CALS STANDARDS OVERVIEW REVISION 1

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This report briefly summarizes the CALS data interchange standards including their purpose, current status, and implementation issues. It concentrates on CALS specifications implemented by MIL-STD-1840, Automated Interchange of Technical Information.

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ABSTRACT

This document presents a brief overview of the initial CALS standards including their purpose, current status, and implementation issues. It concentrates on the CALS specifications implemented by MIL-STD-1840, Automated Interchange of Technical Information.

ADMINISTRATIVE INFORMATION

This report was developed at the Carderock Division, Naval Surface Warfare Center (formerly David Taylor Research Center) under Navy CALS funding for CALS Standards Technical Support sponsored by the Navy CALS Coordination Office, Naval Supply System Command (NAVSUP 06).

1.0 INTRODUCTION

The DoD and Industry Computer-aided Acquisition and Logistic Support (CALS) initiative is an effort to accelerate the use and integration of digital technical information in the weapon system acquisition and life cycle support process. CALS is spearheading a transition from a paper-intensive mode of operation to a digital information environment aimed at improving the efficiency of these processes and quality of the products. Many organizations create and maintain data in digital electronic form. This data represents computer-based models, designs, drawings, engineering data, technical documentation, and manufacturing data.

The Department of Defense (DoD) CALS Evaluation and Integration Office is adopting and developing data and information standards and specifications to provide the common interfaces and neutral file formats necessary for the effective interchange and efficient use of digital technical data. DoD CALS policy is to use existing and emerging national and international standards wherever possible to achieve this objective. Initially, CALS is focusing on standards for the electronic interchange of digital technical information among dissimilar computer systems. These initial CALS standards are intended to enable the digital delivery of engineering drawings, illustrations, technical manuals, and engineering data. Future standards will focus on complete product definition data, product models, and the need to access and manage data within distributed database environments.

This document updates the "CALS Standards Overview" published in May 1992 as Section 9 of the first edition of the "Navy/Marine Corps Manager's Desktop Guide for CALS Implementation". It updates and revises the CALS Standards information to be current with the status of these standards in June 1993. The overview briefly summarizes each of the current CALS standards and addresses their purpose, current status, and implementation issues. It concentrates on the CALS specifications implemented by MIL-STD-1840, Automated Interchange of Technical Information, notably:

1. MIL-STD-1840, Automated Interchange of Technical Information

2. MIL-D-28000, Digital Representation for Communication of Product Data: IGES Application Subsets

3. MIL-M-28001, Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text

4. MIL-R-28002, Requirements for Raster Graphics Representation in Binary Format

5. MIL-D-28003, Digital Representation for Communication of Illustration Data: CGM Application Profile

6. The Interactive Electronic Technical Manual Specifications, MIL-M-87268, MIL-D-87269, and MIL-Q-87270.

Summary information is also provided for Electronic Data Interchange Format (EDIF), VHSIC Hardware Description Language (VHDL), and Hypermedia Time-based Document Structuring Language (HyTime) as they are referenced by MIL-STD-1840. The Open Document Architecture (ODA) standard, though not a CALS standard, is also discussed because of its connection with the CALS raster specification MIL-R-28002. Finally, a section has been devoted to STEP (Standard for the Exchange of Product Model Data). Though not now an official CALS standard, the DoD will adopt STEP for future CALS product model data.

SECTION 2 - AUTOMATED INTERCHANGE OF TECHNICAL INFORMATION MIL-STD-1840B

2.1 PURPOSE

MIL-STD-1840B serves as a central standard for the CALS (Computer-aided Acquisition and Logistic Support) environment. It supersedes and enhances MIL-STD-1840A and standardizes formats for the exchange of digital information between organizations or systems in order to facilitate the development and logistic support of defense systems throughout their entire life cycle.

MIL-STD-1840B defines the format of the data to be exchanged in the CALS environment as well as the mechanisms and the parameters of those mechanisms, required for the exchange to take place. Additionally, MIL-STD-1840B addresses electronic product data, new packaging of data for electronic trade business transactions, and electronic product data technology.

The MIL-STD-1840B standard defines, by reference, the formats and structures of the data files used for the transfer and archival of technical data in digital form. It clearly defines the formats, standardized header records, contents of the files used for the exchange of data as well as requirements during shipment for the labeling, protection, packaging, and the marking of media. The provisions for "protection" of media require that electromagnetically inscribed information transfer media such as encoded magnetic tapes and disks be protected against dirt, moisture, and electrostatic discharge damage during shipment.

2.2 TYPICAL APPLICATIONS

The MIL-STD-1840B standard is designed to be usable for all CALS-related applications where the information can be prepared and received as ASCII (American Standard Code for Information Interchange) text files, product definition data files, raster image files, graphics files, or contract defined data files. This standard is not designed to be usable for specific applications, but is not restricted in any way in its application.

This military standard is intended for technical information which includes product data, product acquisition and implementation data, and product support data. Product data includes engineering drawings, specifications, as well as new and evolving digital data forms which provide the data in a platform independent form directly usable by computer applications. Product acquisition and implementation data includes parameters and data necessary to manufacture and/or acquire an entire defense system. Product support information includes training and maintenance manuals with their associated illustrations needed to maintain a defense system in a required state of readiness. The scope of this data covers the entire life cycle of a weapon system.

MIL-STD-1840B provides general requirements for Technical Publication, Product Data, and Electrical/Electronic Application Data File document types. The Technical Publications document type includes files that contain MIL-M-28001 SGML (Standard Generalized Markup Language), Document Type Declaration with no text, FOSI (Formatting Output Specification Instance), SGML text entity, MIL-D-28000 IGES (Initial Graphics Exchange Specification), MIL-R-28002 Raster, MIL-D-28003 CGM (Computer Graphics Metafile), PDL (Page Description Language), grey scale or color illustration, or special word data.

The Product Data document type includes files that represent engineering drawings in IGES or raster formats as well as Numerical control manufacturing and 3-dimensional piping data files.

The Electrical/Electronic Application Data Files document type includes files that contain information in the following formats: Electronic Design Interchange Format (EDIF), the Very High Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL), IGES Electrical/Electronic application data files, and Institute for Interconnecting and Packaging Electronic Circuits (IPC).

In any typical application, the hardware and software must prepare the files for transfer on the sending system by adding header information and writing the files to the selected media type. The hardware and software on the receiving system must process the files by reading the files from the selected media type and stripping the added header information. The media must also be labeled, protected, packaged, and marked appropriately during shipment in accordance with this standard.

2.3 ARCHITECTURE

MIL-STD-1840B is composed of the following six sections:

Section 1 - SCOPE: Defines the scope of MIL-STD-1840B with respect to standardizing the exchange of digital information between organizations or systems.

Section 2 - REFERENCED DOCUMENTS: Identifies all of the documents upon which MIL-STD-1840B is based (See Section 2.9 of this overview).

Section 3 - DEFINITIONS: Defines the abbreviations and terms used in MIL-STD-1840B.

Section 4 - GENERAL REQUIREMENTS: Specifies the general requirements of mandatory declaration files as well as the specific standards, specifications, and formats required for data files covered by this standard (See section 2.2 of this overview).

Section 5 - DETAILED REQUIREMENTS: Specifies the structure, contents, media options, and the packaging requirements of the digital information constituting a transfer package. It lists file naming conventions for both declaration and data files

along with the header records these files require. The information required in these records includes identifiers of the parent file, text files, data files, as well as destination and source system document identifiers. Packaging requirements specified by MIL-STD-1840B include detailed instructions for labeling, protecting, marking, and packaging the transfer media for shipment.

Section 6 - NOTES: Provides information which is helpful, but not mandatory.

2.4 STATUS AND PLANNED EXTENSIONS

MIL-STD-1840B was released on November 3, 1992. It supersedes MIL-STD-1840A which was released 5 years earlier on December 22, 1987. The next version of this standard is expected in late 1995.

MIL-STD-1840B is required for the delivery of technical CALS data. It's approved for use by all agencies of the Department of Defense (DoD). It has been implemented and used successfully by numerous vendors. The use of MIL-STD-1840B will undoubtedly continue to grow since this standard is at the heart of the CALS interchange environment. The Department of Defense will continue to require that CALS procurements adhere to the requirements of this standard.

The future Revisions of MIL-STD-1840B will address solid modeling for system design, interactive retrieval and use of technical information, and other potential computer applications for defense systems of the future. The interactive retrieval and use of information will be necessary for the implementation of the Contractors Integrated Technical Information Service (CITIS) and the Integrated Weapon System Data Base (IWSDB). It is expected that expert systems will be included in future revisions.

MIL-STD-1840 continues to recognize the format required for IGES information, but does not attempt to address STEP (Standard for the Exchange of Product data model) or PDES (Product Data Exchange standard using STEP) formats. This will be done in future revisions of MIL-STD-1840.

Many of the standards and specifications required or referenced by MIL-STD-1840B are evolving significantly due to rapidly advancing technologies. These will have to be further implemented in future revisions of this standard.

Efforts are currently under way to form a recognized working group with international participation. A target capability (tcap) document is being developed for circulation among the CALS Industry Steering Group (ISG). It recommends that the following areas be addressed in the next revision of MIL-STD-1840B:

- Emerging technologies such as object oriented design, multi-media Interactive Electronic Technical Manuals (IETMs), Electronic Data Interchange (EDI), Electronic Commerce (EC), and ISO STEP.

- Make MIL-STD-1840B media independent.

- Develop a capability for exchange of data bases and data dictionaries via Information Resources Dictionary System (IRDS).

- Handle IETMs, multi-media, and hot links.

- Allign to ISO 10303 (STEP).

- Allign to EDI for Administration, Commerce, and Transport (EDIFACT).

- Handle SGML Document Interchange Format (SDIF).

- Restructure for Telecommunication Standards such as x.400, x.435, x.500 etc.

- Provide improved indexing to systems governed by standard data dictionary.

- Provide for improved security handling consistent with the OSI telecommunications model.

- Provide for better methods for compression and encryption.

- Provide a mechanism for exchange of software and training materials including interactive courseware and simulation training materials.

- Develop and standardize an approach to provide automated technical information (ATI) targeted to interactive storage and retrieval by an end user via technical data repository.

- Provide a "grandfather" clause to accommodate systems and interchanges initiated prior to the current 1840 version.

2.5 ADVANTAGES OF CURRENT STANDARD

MIL-STD-1840B, a standard for interchanging digital technical data, is a core standard for the CALS environment. In addition to the advantage of being required for the delivery of CALS data, this standard has the advantage of having an essential function which facilitates the sharing of technical data within and among autonomous organizations.

This standard clearly defines the mechanisms for exchanging digital data with formats defined in other CALS specifications (MIL-D-28000, MIL-M-28001, MIL-R-28002, and MIL-D-28003). The reference to and use of other standards and specifications allows this standard to evolve, as those standards and specifications evolve, in order to take advantage of advances in current technologies or to use new technologies.

MIL-STD-1840B contains specific detailed instructions for using 9-track magnetic tapes as a medium for exchange of digital data. It contains flexible provisions which rely on agreements between sender and receiver for using other media such as diskettes, WORM (Write Once Read many-times) optical disks, and CD-ROM (Compact Disk Read Only Memory) for the exchange of technical data. This reliance on agreements provides MIL-STD-1840B with the advantage of being accommodating to changing user needs as well as being able to adapt to new requirements and/or guidelines.

Another advantage of MIL-STD-1840B is that it clearly defines the formats, standardized header records, and the contents of the files used for the exchange of data as well as requirements for the labeling, protection, packaging, and the marking of media during shipment. The standard also addresses electronic product data, new packaging of data for electronic trade business transactions, and electronic product data technology.

2.6 IMPLEMENTATION ISSUES

MIL-STD-1840B is required for the delivery of CALS technical data. However, the media for delivery must still be selected. This standard specifies the media for exchange of CALS information and includes provisions for using nine-track magnetic tapes, diskettes, WORM optical disks, and CD-ROM.

Although given recognition as viable CALS media, actual specifications for CD-ROM and WORM optical disks are not clearly defined in this standard. The generic description of requirements leaves room for portability problems in the areas of placement, arrangement, and structuring of files on media other than 9-track magnetic tapes. Informal agreements between sender and receiver must be made to ensure complete portability when CALS data is interchanged on any medium other than 9-track tapes. In addition, other media such as the Bernoulli removable disk drives are not considered, thereby leaving the impression they are not to be used.

Corresponding hardware and software must be present at the preparing (source, sending) site and the receiving (destination) site to accommodate the selected media for the information interchange. The files on the sending system must be prepared for transfer by adding header information to them and writing them to the selected media type. The files must be processed on the receiving system by reading them from the selected media type and stripping the added header information. The configuration management functionality of MIL-STD-1840B requires careful management within the software to assure that correct information is added to the file headers.

MIL-STD-1840B does not handle the frequently encountered problem of multi-volume files. If a file is spread across several volumes (tapes), there are many different ways that the information could be recovered. This is a problem with implementation that has been raised, but not adequately handled in the standard.

The "encouragement" that the data communications protocol specifications of GOSIP (Government Open Systems Interconnection Profile) be used with this standard raises the possibility of the need to implement additional requirements. This results from the fact that GOSIP references other standards such as ODA (Open Desk Architecture). The perceived possibility of additional overhead and requirements resulting from the reference to GOSIP would be resolved if all standards required or referenced by the data communication protocol specifications of GOSIP were clearly identified.

When this standard is referenced by contract, it only applies to contract data called out in the Contract Data Requirements List (CDRL). Each item in the CDRL must be annotated on the respective DD Form 1423 indicating that MIL-STD-1840 specifies the format for delivery. The content of the information to be delivered is defined by the Data Item Description (DID) referenced by the CDRL.

2.7 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

MIL-STD-1840B is approved for use by all agencies of the Department of Defense. It is required for the delivery of all CALS data. This military standard specifies other standards which are widely supported and accepted by national as well as international standards organizations. This provides a strong foundation for user and vendor support.

The real extent of the use of MIL-STD-1840B depends upon the use of the standards of interchange which it specifies. Additional information can be obtained about users and vendors who are implementing MIL-STD-1840B as a part of their implementation of these CALS standards and specifications by reviewing this same section of the summaries for MIL-M-28001 SGML, MIL-D-28000 IGES, MIL-R-28002 Raster, or MIL-D-28003 CGM.

The CALS Test Network (CTN) was established to perform end-to-end testing of the exchange of digital data using MIL-STD-1840B. "CALS-compliant" systems must have the capability of reading and generating data or media conforming to MIL-STD-1840B. Since MIL-STD-1840B is at the heart of the CALS interchange environment, DoD will continue to require that CALS procurements adhere to the requirements of this standard.

2.8 STRUCTURE OF DEVELOPMENT ORGANIZATION

MIL-STD-1840B was developed by the National Institute of Standards and Technology (NIST) under the direction of the Office of the Secretary of Defense (OSD) CALS Office. All of the CALS standards including MIL-STD-1840B are currently being managed by the CALS Digital Standards Office (CDSO), at Wright Patterson Air Force Base, Dayton, Ohio.

2.9 REFERENCE AND IMPLEMENTATION DOCUMENTS AVAILABLE

SPECIFICATIONS

FEDERAL		
PPP-B-636	-	Boxes, Shipping, Fiberboard.
PPP-C-1842	-	Cushioning Material, Plastic, Open Cell (for Packaging Purpose).
MILITARY		
MIL-D-28000	-	Digital Representation for Communication of Product Data: IGES Application Subsets and IGES Application Protocols.
MIL-M-28001	-	Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text.
MIL-R-28002	-	Requirements for Raster Graphics Representations in Binary Format.
MIL-D-28003	-	Digital Representation for Communication of Illustration Data: CGM Application Profile.
STANDARDS		
MIL-STD-1840B	-	Automated Interchange of Technical Information
MIL-STD-804	-	Formats and Coding of Aperture Cards.
MIL-STD-1806	-	Marking Technical Data Prepared by or for the Department of Defense.
HANDBOOKS		
MIL-HDBK-59	-	Department of Defense Computer-aided Acquisition and Logistic Support (CALS) Program Implementation Guide.
MIL-HDBK-331	-	Directory of DoD Engineering Data Repositories

Copies of federal and military specifications, standards, and handbooks are available from the Standardization Document Order Desk, Building 4D, 700 Robbins Ave, Philadelphia, PA 19111-5094.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 8879-1986	-	Information processing - Text and Office Systems
	-	Standard Generalized Markup Language (SGML).

(Copies are available from the American National Standards Institute, 11 West 42nd Street, 13 Floor, New York, NY 10036.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI X3.4-1986	-	American National Standard Code for Information Interchange.
ANSI X3.27-1987	-	File Structure and Labeling of Magnetic Tapes for Information Interchange.
ANSI X3.39-1986	-	Recorded Magnetic Tape for Information Interchange (1600 CPI, P.G.).
ANSI X3.54-1986	-	Recorded Magnetic Tape for Information Interchange (6250 CPI, Group coded Recording).

(Application for copies should be addressed to American National Standards Institute, 11 West 42nd Street, 13 Floor, New York, NY 10036.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 548	-	Electronic Design Interchange Format (EDIF).
EIA 5670000	-	Commercial Component Model Specification.

(Application for copies should be addressed to the Electronic Industries Association, 2001 Pennsylvania Ave. North West, Washington, DC 20006.)

INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)

IPC-D-350	-	Printed Board Description in Digital Form.
IPC-D-351	-	Printed Board Drawings in Digital Form.
IPC-D-352	-	Electronic Design Data Description for Printed Boards in Digital Form.
IPC-D-354	-	Library Format Description for Printed Board Digital Form.
IPC-D-356	-	Bare Board Electrical Test Information in Digital Format.

(Application for copies should be addressed to the Institute for Interconnecting and Packaging Electronic Circuits, 7380 N. Lincoln Ave., Lincolnwood, IL 60646.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1076 - VHSIC Hardware Description Language (VHDL).

(Application for copies should be addressed to The Institute of Electrical and Electronics Engineers, Inc., 345 E. 47th Street, New York, NY 10017.)

SECTION 3 - DIGITAL REPRESENTATION FOR COMMUNICATION OF PRODUCT DATA: IGES APPLICATION SUBSETS AND IGES APPLICATION PROTOCOLS (MIL-D-28000A)

3.1 PURPOSE

MIL-D-28000A is the military specification for the digital representation of product definition data using the Initial Graphics Exchange Specification (IGES) as specified by the American Society of Mechanical Engineers (ASME) standard Y14.26M (Digital Representation for Communication of Product Definition Data). MIL-D-28000A is organized into five classes by application area to meet the delivery needs of that application.

I	Technical Illustrations Subset
II	Engineering Drawings Subset
III	Electrical/Electronic Applications Subset
IV	Geometry for NC Manufacturing Subset
V	3D Piping Application Protocol

The basic unit of information within a MIL-D-28000A class is an entity, such as a line, point, circle, conic arc. The subsets are composed of entities from ASME Y14.26M - 1989, the equivalent of IGES Version 4.0. The Application Protocol (class V) is composed of entities from IGES Version 5.1. A MIL-D-28000A file must use one of the five approved classes, indicating the specific class used in the start section at the beginning of the MIL-D-28000A file.

MIL-D-28000A is maintained by the Office of the Assistant Secretary of Defense (OASD). It is managed for OASD by the CALS Digital Standards Office (CDSO) in Dayton Ohio. Carderock Division, NSWC is the technical agent for MIL-D-28000A. Following is a list of the different versions of MIL-D-28000:

Specification	Date	Change
MIL-D-28000	December 1987	Initial Version - Classes I, II & III. Uses ANSI/ASME Y14.26M - 1987 & IGES 4.0.
MIL-D-28000 Amendment 1	December 1988	Added class IV.
MIL-D-28000A	February 1992	Uses ASME Y14.26M - 1989 & IGES 5.1. Added class V.
MIL-D-28000A Amendment 1	December 1992	Added missing entities.

3.2 SCOPE

MIL-D-28000A specifies five classes of the IGES standard (technical illustrations, engineering drawings, electronic/electronics applications, numerical control manufacturing, and 3D piping) as opposed to the entire IGES standard. MIL-D-28000A subdivides the IGES specification because IGES is large and complex, with different options that may be used to represent the same Computer Aided Design (CAD) model entity. As a result, CAD software vendors seldom support every IGES entity in the specification, but support a subset of IGES that best matches the features of their CAD system. Invariably, there is a mismatch between the set of entities by one CAD system's pre-processor and another CAD system's post-processor. There is no guarantee that the intersection of the two different CAD systems' supported IGES entities is adequate for the required data transfer.

3.2.1 APPLICATION SUBSETS

The first four classes of MIL-D-28000A specify the entities needed for specific application subsets. In this way the recipient of a MIL-D-28000A data file may specify the class of data needed without becoming an expert on the IGES. The only other entities allowed in the file are "volunteer" entities. As stated by MIL-D-28000A, "volunteer" entities must be:

- Valid ASME Y14.26M entities,
- Not necessary for the product data representation, and
- Meant only for restoring the environment on the CAD system that originally developed the file for transmittal.

These requirements are placed on volunteer entities so that the CAD system that receives the file will not lose product information if it does not transfer the "volunteer" entities.

The MIL-D-28000A application subsets specify the entities allowed in that class through a list of ASME Y14.26M entities given in table form. Limits on the entities are given through notes on that table. Rules are also given for the entity construction. Guidance is provided for MIL-D-28000A file construction requirements for each section (start section, global section, directory entry section, parameter data section, and terminate section) of an IGES file for each class.

The subset concept addresses many of the user's problems, but is not an entire solution. One difficulty is that the subsets address the needs of applications by directly specifying the particular IGES entities to be included in the subsets, but do not include enough information on how to use those entities to transfer all the product data typically needed by that application. Most IGES entities are general purpose in nature. They can be combined to create constructs needed for product data transfer, such as a circuit in an electrical application, but they do not rigorously define how this is done. This can be a problem in transfer, because unless the receiving system knows how the IGES entities were combined to create the construct, and has a rigorous definition of the meaning of the construct, that receiving system will not be able to interpret the construct. The basic data is translated, but not all the information needed to translate product data for the application is transferred.

The four application subsets defined within MIL-D-28000A are described in the following paragraphs.

Class I: Technical Illustrations Application Subset. The Class I application subset is for the exchange of illustrations for technical publications. The emphasis is on the visual appearance of the illustrations, not on the functionality of the entities within the class. Class I is a two dimensional subset with limited non-geometric information (such as subfigures).

Class II: Engineering Drawings Application Subset. The Class II application subset is for the exchange of product data following MIL-T-31000 (Technical Data Packages, General Specification for). The emphasis is on completeness, functionality of the drawing model, and visual equivalency for human interpretation. The class contains many geometric entities, annotation entities

and attributes such as color and line fonts, along with organizational information such as levels and subfigures. The geometric entities in this class are three dimensional, though two dimensional data can be transferred by placing all the information on the same plane within the sending CAD system.

Class III: Electrical/Electronic Applications Subset. The Class III application subset is for the exchange of product data for electrical and electronic products. The emphasis is on completeness and functionality of the model for design, manufacturing and testing. Class III supports both the logical product representation and the physical product representation, which can both be in the same file. The logical representation includes netlists and schematics, while the physical representation includes assembly placement and pad layouts.

Class IV: Geometry for NC Manufacturing Application Subset. The Class IV application subset is for the exchange of product data for manufacturing by numerical control. The emphasis is on the completeness and functionality of the part model. Geometry data is either 2-D wireframe, for profiles or sheet metal, or a 3-D wireframe model, for multi-axis machining. Precision and accuracy on the wireframe and surface geometry must be maintained, as well as first order continuity. Geometry and Text form the majority of the data for this class.

3.2.2 APPLICATION PROTOCOLS

An Application Protocol (AP) is a way to transfer defined product data through IGES. An AP documents the user requirements for an application in a graphical model called an Application Reference Model (ARM). The requirements in the ARM are then represented by specific IGES entities in a given AP (the AIM). APs enable IGES to be used to transfer product data reliably until PDES/STEP is available from the commercial CAD vendors. APs provide a defined and more reliable method for transferring product data through IGES.

An AP is composed of the following elements:

- A scope and requirements section;
- An Application Reference Model (ARM) of the supported information that explains what is covered in the application and how the different elements relate to one another;

- An Application Interpreted Model (AIM) that shows how the information is mapped into IGES entities; and
- Conformance Requirements and Abstract Test Purposes.

APs are very specific in nature. For example the 3D Piping AP (Class V) exclusively supports the exchange of product data for 3D piping system models. It does not support piping engineering drawings. A user wishing to transfer an engineering drawing of a piping system would have to use an Engineering Drawing AP. Also, only CAD/CAM systems supporting piping will be able to support the piping AP. A CAD/CAM system that does not support piping just doesn't have the appropriate constructs within its' database to either output data in the Piping AP, or input the data reliably. APs will provide increased information transfer, but with a much narrowed scope in the information that is transferred.

Class V: 3D Piping Application Protocol. The Class V application protocol is for the exchange of product data for 3D piping system models, but not piping drawings or internal details of equipment. The Class V AP conveys shape and location, connectivity, material characteristics, information about elements in the piping system and the piping system as a whole. The Class V provides information for the core requirements of: interference analysis, connectivity checks, basic parts lists, graphics presentation, basic piping isometrics, pipe bending instructions, and limited piping redesign. This Class V AP is not intended for general purpose CAD system, but for 3D piping system applications only. Both the sending and receiving systems must support the 3D piping system application and the Class V 3D Piping Application Protocol for meaningful exchange.

3.3 STATUS AND PLANNED EXTENSIONS

MIL-D-28000A is based upon an underlying American National Standard (ASME Y14.26M - 1989) and the Initial Graphics exchange Specification (IGES) Version 5.1, both of which were developed by the IGES/PDES Organization (IPO). As such, the OASD CALS Evaluation and Intergration Office (EIO) cooperates with the voluntary IPO through the IPO's CALS/IGES Special Interest Group (SIG). The CALS/IGES SIG reviews proposed changes and suggests new changes at the IPO meetings. The CALS/IGES SIG is a source of IGES technical expertise and is instrumental in ensuring the quality of revisions or amendments to MIL-D-28000A.

A new application protocol, the Engineering Drawings Application Protocol (AP),

is being developed for MIL-D-28000A. It is being created by members of the Navy Industry Digital Data Exchange Standards Committee (NIDDESC) and the IGES/PDES Organization. The AP will be submitted to the OASD CALS EIO for inclusion in the next amendment or revision of MIL-D-28000.

Review and comments generated in the year and a half that MIL-D-28000 has referenced that AP, has resulted in the generation the 3D Piping AP version 1.2. The 3D Piping AP version 1.2 is under a mail ballot vote of the IPO general assembly. After the AP is approved, it will be published by USPro (the parent organization for the IPO) as a companion standard to the IGES specification and submitted to the OASD CALS EIO for inclusion in the next amendment or revision of MIL-D-28000.

3.4 IMPLEMENTATION ISSUES

The method by which the senders of a MIL-D-28000A file will produce application subsets is a possible concern for the implementation of MIL-D-28000A. The preferred method is for the originator's CAD system's IGES translator to produce the MIL-D-28000A file. But, an alternative method is for the CAD system to produce the IGES file which is subsequently run through commercial flavoring software to produce the MIL-D-28000A compliant file. This method must be performed very carefully to prevent any loss of the file's underlying structure, and is not suited for the transfer of application protocols.

Even perfect transfer of the application subset does not ensure that all of the information in the original CAD model will be translated. For example, a CAD system may recognize objects such as resisters and capacitors in its internal data base, but since IGES has no standard way to represent such objects, these objects may be transferred as a grouping of points, lines and curves which represent the object. The concept that a group of entities represent an object is not necessarily conveyed by the subset to the receiving CAD system. MIL-D-28000A displays an awareness of this problem by specifying that "It is the intent of this specification to evolve in the direction of application protocols to ensure quality data exchanges". The application protocol work is being developed within the IGES/PDES Organization to transfer objects within an application area instead of merely a geometric representation with little standardized intelligence attached. The 3D Piping AP is the first AP developed by the IPO.

Most IGES entities are general purpose in nature. They can be combined to create constructs needed for product data transfer, such as a circuit in an electrical application, but they do not rigorously define how this is done. This can be a problem in transfer, because unless the receiving system knows how the IGES entities were combined to create the construct, the receiving system may not be able to interpret it. The basic data will be translated, but all the information needed to translate product data for the application will not be available.

MIL-D-28000 does not contain any rationale for why a specific set of entities was chosen for an application subset over another set of entities. This can make extensions to the subsets laborious, and raises many questions from the user and vendor community.

3.5 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

The IGES specification has much support from CAD system vendors. Most CAD systems have some type of IGES translator, and even some non-CAD systems, such as Interleaf (an electronic publications system), support the IGES specification. The support for MIL-D-28000 (i.e., the subsets) is not as widespread as the support for the full IGES standard. The greatest stated support of the subsets comes from the commercial flavoring software and syntax checking software. MIL-D-28000 Class II, engineering drawings, is the most commonly supported class, followed by MIL-D-28000 Class I, technical illustrations. Intergraph has a MIL-D-28000 Class V translator under development.

3.6 STRUCTURE OF DEVELOPMENT ORGANIZATION(S)

The MIL-D-28000A (IGES subsets and APs) specification is being developed jointly by the Department of Defense (DoD), federal agencies and private industry, under the direction of the Department of Defense. Comments are solicited through the postage paid Standardization Document Improvement Proposals (DD Form 1426) at the back of the MIL-D-28000A specification. The comments that are accepted are incorporated into a coordination draft amendment or revision to the standard. This coordination draft is circulated to Government and Industry for comment. The comments are reviewed and incorporated, then a new version of the specification is issued.

The CALS Digital Standards Office (CDSO) in Dayton Ohio is the administrative

agent for the MIL-D-28000A specification. The CDSO is responsible for distributing the draft specification for comment, receiving and tracking the comments, holding the comment coordination meetings, updating the draft specification with the comments, and supplying the completed document to OASD for approval.

The IGES/PDES Organization (IPO) develops and maintains the standard upon which MIL-D-28000A depends, the Initial Graphics Exchange Specification (IGES). The IGES project is guided by the IGES Project Manager, Mr. Greg Morea of General Dynamics/Electric Boat. Changes to the specification are submitted as Request For Changes (RFCs), which are balloted by mail to members of the IPO on a quarterly basis. An RFC is approved if the majority of the ballot votes are favorable and all unfavorable votes are classified as not persuasive by the IPO Technical Committee responsible for the RFC. An Engineering Change Order (ECO) is then prepared for the approved RFCs by the technical committee and submitted to the IGES Editor for inclusion into the next IGES version.

The IPO has been accredited as an American National Standards Institute (ANSI) standards making body for product data exchange in 1992. IGES Version 5.2 will become the first national standard directly created by the IPO. Before the IPO received ANSI accreditation, the IPO submitted the IGES specification to the American Society of Mechanical Engineers (ASME) Y14.26 committee (Engineering Drawing and Related Documentation Practices) for approval, and for publication as a national standard. This process generally took a years time, which lead to a substantial delay between publishing of the IPO specification and publishing the national standard.

The OASD CALS EIO cooperates with the voluntary IPO through the IPO's CALS/IGES Special Interest Group (SIG). The CALS/IGES SIG is a source of IGES technical expertise and is instrumental in ensuring the quality of revisions or amendments to MIL-D-28000. The CALS/IGES SIG was a significant contributor to MIL-D-28000 Revision A.

The CALS Industry Steering Group (ISG) Standards Task Group (STG) Drawing and Graphics Committee (DAGC) also participates in the maintenance of MIL-D-28000A. The DAGC's interest is in examining and evaluating graphics standards for CALS (such as MIL-R-28002 (Raster), MIL-D-28003 (CGM) and MIL-D-28000A (IGES)). Issues developed by the DAGC are documented as TCAPS (Technical CAPabilitieS). TCAPS that are approved by the ISG are forwarded to the OASD CALS EIO for consideration. The DAGC maintains liaison relationships with the other graphics organizations, such as the IPO, to keep

current with changes to the evolving standards.

3.7 TESTING AND VALIDATION

The CALS Test Network (CTN) was established to demonstrate the CALS standards, test their effectiveness, and identify needed improvements to the standards. Currently, the CTN tests only the CALS data interchange standards. The CTN uses naturally occurring tests and structured tests. After the test results have been reviewed and approved by the CTN, the test reports are put on the CALS Bulletin Board for public view. The CTN testing performed by Industry participants and lead testbeds, is directed by the CALS Test Network Office reporting to the Standards and Technology Division of the CALS EIO. The lead testbed for MIL-D-28000A is the Carderock Division of the Naval Surface Warfare Center (NSWC). Joe Garner, 301 227-1533, is the point of contact.

The CTN has test packets for testing MIL-D-28000 Class I and II, which currently need to be upgraded to the MIL-D-28000A version. Test cases for Class V are currently under development. The CTN does not have test packets for Classes III or IV. the main contents of the CTN test packets are: IGES files to process into the CAD system, scripts to follow in creating the data on the CAD system for subsequent output, and plots to show the expected results. The test results from the naturally occurring tests are called "Quick Short Test Reports" (QSTRs) and are available from the CTN or the CTN Bulletin Board.

A CTN report describes the digital data exchange between General Dynamics/Electric Boat and Newport News. It is titled "SEAWOLF Digital Data Transfer Program: Implementation of IGES for the Acquisition of a Major Weapons System", CTN Report Number 91-004. The report is a good example of the use of IGES in the development of a major weapons system platform.

3.8 REFERENCE AND IMPLEMENTATION DOCUMENTS AVAILABLE

1. ASME Y14.26M - 1989, Digital Representation for Communication of Product Definition Data.

   (Copies of ASME Y14.26M may be ordered from: The American Society of Mechanical Engineers, 345 East 47th Street, New York, N.Y. 10017.
   OR

American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.)

(ASME Y14.26M was adopted by DoD on 22 December 1989. DoD activities may order ASME Y14.26M from: Department of Defense Single Stock Point, Commanding Officer, Naval Publications and Forms Center (NPFC), 5801 Tabor Avenue, Philadelphia, PA 19120.)

2. CALS Test Network Handbook, July 1991.

3. CALS Test Network MIL-D-28000 Class I IGES Reference Illustration Packet.

4. CALS Test Network MIL-D-28000 Class II Reference Drawing Packet.

(Copies of CTN Reports and test packets are available free of charge from: Cathy Murphy, AFLC LNSC/SBC, Area C, Building 89, WPAFB, OH 45433-5000.)

5. Initial Graphics Exchange Specification (IGES) Version 5.1 (September 1991).

(Copies of the IGES 5.1 may be ordered from: the National Computer Graphics Association (NCGA), Administrator, IGES/PDES Organization, 2722 Merilee Drive, Suite 200, Fairfax, VA 22031. Or call NCGA Technical Services and Standards, Nancy Flower, 703 698-9600 extension 325.)

6. MIL-D-28000A, Digital Representation For Communication of Product Data: IGES Application Subsets and IGES Application Protocols.

7. MIL-HDBK-59A Department of Defense Computer-Aided Acquisition and Logistics Support (CALS) Program Implementation Guide.

8. MIL-STD-1840B Automated Interchange of Technical Information.

(The CALS Specifications and Standards are available free of charge from the CALS Bulletin Board: 703 321-8020. For a nominal charge, the CALS specifications and standards nay be ordered from the National Technical Information Service, Springfield, VA 22161.

SECTION 4 - STANDARDIZED GENERALIZED MARKUP LANGUAGE (SGML) MIL-M-28001B

4.1 PURPOSE

MIL-M-28001B establishes requirements for the digital interchange of technical publication text. Data prepared in conformance to MIL-M-28001B will facilitate the automated storage, retrieval, interchange, and processing of technical documents from heterogeneous data sources.

The latest draft of MIL-M-28001B, prepared by OASD(P&L) CALS and dated 5 January 1993, has undergone some modification and has been approved for publication by 30 June 1993. The draft specifications should not be used for acquisition purposes until released as a formal specification.

The CALS standard MIL-M-28001B is the DoD implementation of the International standard ISO 8879 "Standard Generalized Markup Language (SGML)". Some familiarity with SGML is needed to understand MIL-M-28001B.

The CALS SGML standard defines both a methodology and a high level computer language for document representation. It provides a coherent and unambiguous grammar and syntax for describing whatever a user chooses to identify within a document regardless of the type of document or the nature of the document's text and provides a formal markup procedure, also independent of system and output environments for this purpose. The definition of the document's structure or content in terms of "elements", their "attributes", "entities", and other components is a called "Document Type Definition (DTD)". A DTD defines the structure or content of a specific class of documents.

"SGML markup" (or an "SGML instance") consists of unformatted text with inserted SGML "tags" which correspond to the elements and attributes of the DTD. These tags identify elements of the text (e.g., titles, paragraphs, tables, footnotes) defined in the document's DTD. The "marked up" document (or SGML instance) can then be "parsed" using special software to determine if the document's tagging conforms to the DTD.

Unlike MIL-M-28001A which contained the DTD for documents conforming to MIL-M-38784B and 12 DTDs based on that DTD, MIL-M-28001B will not contain any DTDs to be used for delivering data to the Government. Like MIL-M-28001A, MIL-M-28001B will provide the so-called "template" DTD in appendix A. Its chief function is to serve as a "toolkit" for the construction of DTDs by providing SGML coding that can incorporated or modified in DTDs being developed. The template DTD also provides a set of elements and attributes for use in new DTDs.

A "declaration subset" is used to define a new DTD in terms of changes to an existing DTD. The implementation of the changes in a declaration subset results in a complete and different DTD for the corresponding military specification. The use of such "declaration subsets" in creating new DTDs this way actually allows tighter control over the number of distinct DTDs. While DoD wishes MIL-M-28001B to be implemented in a wide variety of applications, DoD is also quite concerned with the uncontrolled proliferation of DTDs.

New DTDs must be developed for all applications of automated technical publications for which existing CALS DTDs are inadequate. New DTDs should be constructed using those elements and attributes of the "template" DTD as defined in Appendix A of MIL-M-28001B whenever possible. This Appendix provides general guidance for development of DTDs. The DTD for a given class of documents such as technical manuals will either be provided in the governing specifications for such documents or else be completely specified within the specification.

4.2 APPLICATIONS

The development of those CALS DTDs contained in earlier versions of MIL-M-28001 and based on the DTD for MIL-M-38784B conforming documents was a coordinated effort of the Navy, Army, Air Force, and Industry. MIL-M-38784B has been superseded by MIL-M-38784C, and the DTD for documents conforming to MIL-M-38784C is provided in appendix B of MIL-M-38784C. In addition, numerous other DTDs were develooed, including those DTDs developed by the Air Force under the Technical Manual Specifications Standardization (TMSS) program, and a Work Package DTD developed for Naval Air Systems Command (NAVAIR). These DTDs will be included or referenced in the appropriate functional specifications.

Currently, MIL-M-28001B is concerned with the digital interchange of paper-based manuals. However, efforts are underway to define the digital interchange of "paperless", i.e., screen medium technical publications. A draft specification, MIL-D-87269, uses SGML to specify a revisable data base for the support of interactive electronic technical manuals.

4.3 ARCHITECTURE

MIL-M-28001B is composed of the following six sections and 3 appendices:

Section 1 - SCOPE: Defines the scope of MIL-M-28001B with respect to establishing requirements for the digital data form of page-oriented technical publications.

Section 2 - APPLICABLE DOCUMENTS: Identifies the documents upon which MIL-M-28001B is based.

Section 3 - REQUIREMENTS: Defines the general requirements imposed upon publications prepared with respect to MIL-M-28001B.

Section 4 - QUALITY ASSURANCE PROVISIONS: Defines contractual requirements for quality assurance of supplies and services.

Section 5 - PACKAGING: Defines packaging requirements as per MIL-STD-1840.

Section 6 - NOTES: Identifies additional capabilities of the specification.

a. Section 6.1 "Intended Use" outlines the multi-step preparation of technical publications in an automated SGML support environment.

b. Section 6.4 "Baseline Publication Types" addresses the various aspects of document delivery in detail.

c. Section 6.5 "Publication Management and Processing Considerations" discusses various technical issues such as DTD preparation and source file configuration control relevant to publication management.

d. Section 6.5.3 "Electronic Review" discusses the procedure for electronic review of documents on a network and the consolidation of these comments for possible implementation. This is a new addition to MIL-M-28001.

e. Section 6.5.4.1 describes the methodology of partial document delivery.

Appendix A - TEMPLATE DOCTYPE FOR TECHNICAL DOCUMENTS / MARKUP TAGS: Contains the following significant material.

a. Section 30 "Introduction" provides a summary of the SGML grammar and syntax defined in ISO 8879 and also provides the SGML Declaration used by the MIL-M-28001B implementation of SGML.

b. Section 50 "Example Doctype For Technical Documents" provides a general purpose DTD which is intended to be used as a "tool kit" for constructing DTDs, rather than as a DTD in its own right.

c. Section 60 "Alphabetical Listing Of Tag Descriptions" contains descriptions of all elements defined in the "template" DTD.

d. Section 70 "Alphabetical Listing Of Attribute Descriptions" contains descriptions of commonly used sets of attributes.

Appendix B - OUTPUT SPECIFICATION: Contains the following significant material.

a. Section 30 "Output Specification (OS) Concepts" briefly defines the Output Specification (OS) concept.

b. Section 40 "Key To Characteristics" describes the use of the Output Specification characteristics.

c. Section 50 "Interchange Format" contains the Output Specification DTD.

d. Section 60 "Guidelines" describes in detail a 16 step procedure for writing a FOSI.

Appendix C - LIBRARY OF AVAILABLE CHARACTER ENTITY DECLARATIONS/LIBRARY OF AVAILABLE DATA CONTENT NOTATIONS/LIBRARY OF AVAILABLE REPLACEMENT TEXT ENTITY DECLARATIONS/LIBRARY OF AVAILABLE PUBLIC TABLE DECLARATIONS: Contains the following significant material.

a. Section 30 "Character Set Entity Declarations" provides the ISO sets of character entity declarations for providing characters not available on the standard keyboard.

b. Section 40 "Data Content Notation Declarations" provides data content notation declarations for "iges", "fax", etc. external entities.

c. Section 50 "Replacement Text Entity Declarations" provides entity declarations for "boilerplate" text.

d. Section 70 "Math Declaration Set" provides element and entity declarations for mathematical notation.

e. Section 80 "Electronic Review Declaration Set" provides element and entity declarations to support the electronic review of SGML-tagged publications.

4.4 STATUS AND PLANNED EXTENSIONS

It is in the interest of both DoD and industry to agree on the widest applicable set of conventions for the preparation and interchange of publications for defense and non-defense use. MIL-M-28001B has identified applications which exceed the scope of ISO 8879 and which provide a more comprehensive specification for the interchange of ASCII data. Such applications include the specifications for an Output Specification, Electronic Review, and Partial Document delivery. These specifications represent the chief enhancements of the MIL-M-28001 specification achieved by the "B" version and are briefly discussed below.

4.4.1 OUTPUT SPECIFICATION

In order to format an SGML source file, associated formatting information must be provided. This associated formatting information must define formatting characteristics such as a page model, font and family characteristics, point size, indenting, etc. In addition, these formatting characteristics must be responsive to certain SGML tags. For example, a "paragraph" tag may trigger a change in the line leading or a "chapter title" tag may trigger "bolding" and "center" functions. The Electronic Publishing Committee of the CALS Industry Standards Working Group formed a "MIL-M-28001 Output Specification Ad Hoc Group" to develop a standard language for providing the associated formatting information of SGML instances. It was decided to use SGML itself for this purpose and provide the associated formatting information in the form of an "Output Specification" (OS) DTD. Appendix B, Section 50 of MIL-M-28001B contains

the CALS paper medium OS DTD.

The OS DTD defines a finite set of formatting characteristics used to rigorously describe the composition processing functions to be performed with respect to the tags of a SGML source file. A Formatting Output Specification Instance (FOSI) is an instance of the OS DTD. The FOSI defines values for the formatting characteristics defined in the OS DTD for every SGML element used in the document DTD, taking into account every context in which the SGML element has a unique formatting requirement, as would be the case where a title of a TM chapter is formatted differently than a title of a TM subparagraph. The objective of the FOSI is to rigorously define the format style of the document to be produced from the SGML tagged source file, as required by the appropriate functional specification (MIL-M-38784C, etc.).

A FOSI should be developed for each DTD to describe all default formatting characteristics necessary to compose and publish a document authored according to that DTD. The FOSI should be delivered with the SGML source file. Since all FOSIs will be written with respect to the standard OS (paper medium), vendors will be able to develop software that can accept and process FOSIs and interface with the publishing software. However, though desirable, such automatic processing of a FOSI is not a requirement of MIL-M-28001B.

4.4.2 ELECTRONIC REVIEW

Section 80 of appendix C of MIL-M-28001B provides a mechanism which enables an electronic review and comment capability for SGML source files. This capability enables reviewers located in diverse environments to make and exchange comments electronically on multiple copies of a document file over a network. The comments may then be sorted, processed, and incorporated into the document by the file "owner".

The mechanism for electronic review of SGML source files consists of certain SGML constructs which are incorporated into a DTD for a given document type. These SGML constructs have been defined as generically as possible to take into account the many kinds of reviews: internal contractor reviews, Government reviews, contractor/Government reviews, specification reviews, etc.

Plans for future extensions of electronic review include both a CALS graphics comment capability using SGML for the comments, and a capability to link SGML text and CALS graphics files for related changes. Efforts will also be made to develop a more precise addressing mechanism for indicating location within document elements affected by a proposed change.

4.4.3 PARTIAL DOCUMENTS

Partial document delivery is used to transmit source SGML data either as an interim deliverable or as an update package containing data for a document that has been previously delivered. Its purpose is to minimize the retransmittal of unchanged data or

to indicate incomplete data. Partial document delivery is not intended to address the issues of page integrity or fidelity, nor is it intended to include specific change pages. The intent of this methodology is to allow the delivery of certain portions of a source document such that the receiving system can identify the location of the information in the original document and perform the appropriate addition, deletion, or replacement operations. Both the manner in which this is accomplished and the effect of the change on composition depends on the receiving system.

4.4.4 CALS SGML REGISTRY/CALS SGML LIBRARY

One of the Ad Hoc Groups of the Electronic Publishing Committee is investigating the requirements for the development and maintenance of a CALS SGML Library (CSL).

It is envisioned that a CALS SGML Registrar will administer the CALS SGML Registry (CSR), a central registry office where DTDs and FOSIs will be registered. The CSR will maintain a CALS SGML Library will be an on-line database containing all SGML elements and attributes that have been defined, with cross references to DTDs and governing military specifications. It is anticipated that all CSR/CSL requirements will be specified in a future revision of MIL-M-28001.

The CALS SGML Registry will require adherence to basic guidelines for acceptance of SGML tags/attributes. These guidelines include:

- Querying the CSL for a suitable registered DTD in lieu of developing a new DTD

- IIf a new DTD is to be developed, compare tag requirements with the tags currently registered in the CSL. Utilize "generic" elements as much as possible. For example, the requirement for a "group assembly parts list" can utilize an existing CSL element "pl" (parts list). This way, the CSL should not contain "redundant" elements, i.e., different tags for the same information.

- If no existing CSL tag is suitable, develop a new tag and submit it to the CSR for acceptance into the CSL. The CSR will require that the tag be unique (i.e., no existing CSL element will suffice); that (if possible), a generic tag name be used to facilitate DoD-wide use; and that the tag name satisfy naming conventions defined by the CSR.

4.5 ADVANTAGES OF CURRENT SPECIFICATION

MIL-M-28001B provides SGML applications or "conventions" that can be applied in the automation of document production and management. These applications include the Output Specification, Electronic Review, Partial Document Delivery, and the "template" DTD tagset of elements and attributes. These innovations which are oriented toward

DoD and industry needs will provide a comprehensive specification for the interchange of ASCII data. They constitute both a far-sighted adaptation and a wide-ranging application of ISO 8879 to the rapidly changing technology of the printing and publishing industry.

4.6 IMPLEMENTATION ISSUES

MIL-M-28001 has undergone extensive revisions since its initial publication on 26 February 1988. MIL-M-28001B contains various specifications and/or recommendations for the interchange of data. Some of these have not been thoroughly tested, including:

- the method for tagging mathematical equations
- the sufficiency of OS/FOSI to describe format requirements
- the linkage of SGML source files with graphics
- the receipt of partial "change package" documents from contractors

Currently, there are no tests for vendor products claiming conformance to MIL-M-28001. Such MIL-M-28001 product conformance testing will depend upon the product's function. For instance, conformance testing of SGML parsers entails the correct interpretation of ISO 8879. Conformance testing of "auto-taggers" or "authoring stations" would be limited to determining the parseability of the instances generated, and again would involve correct ISO 8879 interpretation. With very few exceptions, there is no disagreement regarding the correct interpretation of ISO 8879.

However, conformance testing of CALS SGML publishing systems involves MIL-M-28001 compliance but MIL-M-28001 does not rigorously define system requirements. For example, while MIL-M-28001 specifies the requirements of a FOSI, it does not require a system to automatically process such a FOSI. Therefore, MIL-M-28001B conformance testing of a publishing system would likely be limited to tests for CALS data acceptance and valid document formatting.

4.7 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

The vendor community is aware of the evolving nature of MIL-M-28001. Some vendors are waiting until the standard is finalized, while other vendors are undertaking full implementations at the present time. A large vendor community is represented on the Electronic Publishing Committee. For the CALS environment, vendors supporting MIL-M-28001 should not "hard-code" their systems to process only a single DTD or FOSI. Certainly, most users will be processing a variety of technical publications which must conform to multiple DTDs and will require a system that can be configured to adapt to new and changing requirements as they arise.

Currently there are various types of SGML software products on the market.

These include:

- SGML parsers which conform to ISO 8879. Such parsers check DTDs for conformance to SGML grammar and syntax. They also check document instances for conformance to a given DTD. They return error reports on errors found in the parsing process. Many other SGML software packages (e.g., SGML editors) come with a "built-in" parser.

- SGML authoring and editing software which "understands" the DTD as it is given. Such software guides an author through the creation of a document, not requiring the author to type in the SGML tags. The keyed-in text is automatically formatted and displayed (non-WYSIWYG) on the screen.

- SGML Publishing systems which accept an SGML-tagged document and associated graphics and compose the entire document in accordance with the document's format specifications, whether in the form of a FOSI, or system-internal "style-sheet".

- Software which automatically tags an ASCII file based on format-driven triggers. Most of the "structure" type tags (for paragraphs, lists, etc.) can be automatically generated without any trouble. However, unless the software is very sophisticated, the "content" type tags (for cross references, equipment numbers, etc.) cannot be automatically generated. Content type tags are very important in data base applications. This "auto-tagging" software can be used in conjunction with media converters to translate formatted "system-dependent" files (I.e., "WordPerfect") into SGML files.

4.8 STRUCTURE OF THE DEVELOPMENT ORGANIZATION

The Electronic Publishing Committee (EPC) of the CALS Industry Standards Working Group (ISWG) has served as the MIL-M-28001 development organization, responsible for reviewing industry and Government comments with respect to the standard. The CALS Digital Standards Office, an OSD chartered organization located at Wright Patterson Air Force Base, Dayton, Ohio, is responsible for publishing and managing MIL-M-28001.

The EPC has formed 7 Ad Hoc sub-committees to determine and specify additional features for the DOD implementation of SGML. These Ad Hoc Groups are tasked with planning the implementation of the EPC's agenda for MIL-M-28001.

Ad Hoc 1 - Change Package

Ad Hoc 2 - CALS SGML Library (CSL) and CALS SGML Registrar (CSR)

Ad Hoc 3 - FOSI/Output Specification and DSSSL (Document Style Semantics Specification Language)

Ad Hoc 4 - Specification Reorganization

Ad Hoc 5 - Advanced Data Concepts (IETM, etc.)

Ad Hoc 6 - Electronic Review

Ad Hoc 7 - Oversite Committee

4.9 REFERENCE AND IMPLEMENTATION DOCUMENTS

The primary SGML reference document is the International Organization for Standardization publication, ISO 8879 "Information Processing - Text and Office Systems - Standard Generalized Markup Language (SGML)". This is the authoritative source for SGML, and it provides the most general description of SGML. All non-proprietary SGML implementations are based on the meta-language defined therein.

Additional documents providing general and technical background information on SGML are:

(1) "SGML: The User's Guide to ISO 8879" by Joan M. Smith and Robert Stutely (John Wiley, 1988) - chiefly an index and cross-reference to ISO 8879.

(2) "The SGML Handbook" by Charles M. Goldfarb (Oxford University Press, 1990) - essentially an annotated version of ISO 8879.

(3) "SGML An Author's Guide to the Standard Generalized Markup Language" by Martin Bryan (Addison-Wesley, 1988) - a general introduction to SGML.

(4) "Practical SGML" by Eric van Herwijnen (Kluwer Academic, 1990) - another general introduction to SGML.

SECTION 5 - RASTER GRAPHICS REPRESENTATION IN BINARY FORMAT (MIL-R-28002)

5.1 PURPOSE

The MIL-R-28002 specification establishes requirements for a standard interchange file format and raster encoding scheme for raster data. MIL-R-28002 (Type I and Type II as defined in NISTIR 88-4017) was first issued in December 1988. It was revised by MIL-R-28002A in November of 1990 and again by MIL-R-28002B, 14 December 1992. This specification identifies the requirements to be met when raster data represented in digital, binary format are delivered to the Government.

Raster graphics involves the digital processing, storage, exchange and reproduction of images. This technology supports the binary representation of a two-dimensional image as an array of picture elements, also known as pels. Each pel of the array contains information about that portion of the image. This information may include its lightness, darkness, gray-level and color. The quality of the image depends directly on the density of pels within the array, also known as resolution density or pel transmission density. A high resolution density provides a high quality image, but at the expense of higher storage costs. Data compression, in which an encoding scheme is used to represent redundant data bits of information, can alleviate this storage problem to some extent. MIL-R-28002 restricts such compression to Group 4 encoding as defined in Consultative Committee on Telegraph and Telephone (CCITT) Recommendation T.6 (FIPS PUB 150) in order to conform with developing industry standards.

MIL-R-28002 permits two types of digital representation of raster data, called Type I and Type II in the specification. The Type I file format is used for raster data contained in a single monolithic block of compressed data and is called untiled raster data. The Type II file format is an Open Document Architecture (ODA) document (as specified by ISO 8613 ODA) conforming to a special application profile for raster. Type II may be tiled raster data or may consist of a single compressed block of data as in Type I, but with all ODA parameters and data structuring included.

Tiled raster data consists of an image that is subdivided into non-overlapping regions known as tiles where each tile is treated as a separate pel array. This method is especially useful for mechanical drawings in which there are large open areas of space. Figure 5-1 shows an image overlayed with a grid coordinate system to produce the tile subdivisions. Within a single image, tiles are equal in size and their dimensions, specified in terms of pels, have certain limitations. Tiles can be compressed and manipulated to obtain an optimal raster file. However, it is possible that compression can result in an enlarged set of data ("negative compression"), especially in busy areas of the image. Therefore, compression must be employed with care. In such situations, an optimal raster file can be obtained using a mixture of compressed and

uncompressed tiles. MIL-R-28002 specifies that individual tiles be digitized and the data compressed in accordance with Group 4 encoding defined in Recommendation T.6 (FIPS PUB 150). In cases where negative compression occurs, MIL-R-28002 allows transmission of the raster bitmap.

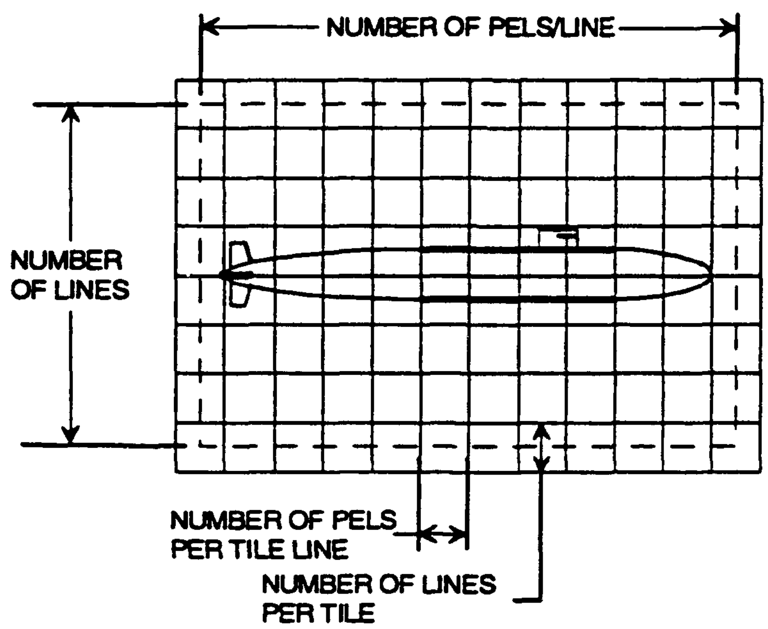

Figure 5-1 Tiled Raster Graphics Example

Type I raster data interchange is intended to be used in procuring data for systems that only use untiled raster data representations. Examples of such systems include typical technical documentation systems, the Air Force Engineering Data Computer-Assisted Retrieval System (EDCARS) and the Army Digital Storage and Retrieval Engineering Data System (DSREDS). A set of graphics attributes specifying the details necessary for processing and reproducing the image must be included in a header record at the beginning of the raster file. These attributes include the size of the original image, the scanning resolution, the image orientation (portrait or landscape), the starting position on the page, and the spacing between the pels and also between the lines containing the pels. These attributes are used in reproducing the image and apply to both Type I and Type II raster data files.

Type II raster data interchange is intended to be used in procuring data for systems that need the flexibility to use tiled or a mixture of tiled and untiled raster data representations. Tiled representations are best applied in systems handling large format drawings or illustrations typically associated with engineering design. The subdivision of a drawing into tiles allows the use of only those portions of an image

required at a given time by the application. This can result in reduced requirements for workstation memory and display. The attributes required for Type I are also required for Type II data and are encoded in the ODA data stream as specified by the ODA Raster DAP (explained below). For Type II data, additional attribute information must be included to cover the size of each tile, the number of tiles in the array (image), the method of tile ordering, and the method of tile coding. This information is stored in the header record of an image file during the scanning process and is essential for reproducing the image.

5.2 TYPICAL APPLICATIONS

MIL-R-28002 was created for the storage and interchange of scanned engineering drawings but applies to other documents as well, such as technical manuals and illustration in raster form.

Appendix A of MIL-R-28002B contains the Open Document Architecture (ODA) Raster Document Application Profile (DAP). The DAP specifies an interchange format suitable for transfer of structured documents between equipment designed for raster processing. The documents supported by the Raster DAP are based on the paradigm of an electronic drawing or illustration. Such documents contain one or more pages. Each page consists of an image in the form of a bi-tonal raster graphic content. There is no restriction on the minimum size of the image. The DAP allows large format raster documents to be interchanged in a formatted form in accordance with ISO 8613 (ODA) summarized in Section 11 of the overview document.

The features of a document that can be interchanged using the Raster DAP fall into the following categories:

- Page format features - these deal with how the layout of each page of a document will appear when reproduced;

- Raster graphics layout and imaging features - these deal with how the document content will appear within pages of the reproduced document; and

- Raster graphics coding - these deal with the raster graphics representations and control functions that make up the raster graphics content.

5.3 ARCHITECTURE

MIL-R-28002 identifies the requirements to be met when raster data represented in digital, binary format is delivered to the Federal Government. This specification identifies the storage and transmission format of raster data and tiling conventions for document pages and large format engineering drawings interchanged as raster images. All digital raster data files complying with MIL-R-28002 shall conform to either the Type I or Type II binary formats defined in the specification.

As specified in MIL-STD-1840, a set of graphics attributes specifying the details necessary for processing and reproducing the image is contained in a header record at the beginning of a raster file. These attributes include an indication of the raster data type, the size of the original image, the scanning resolution, the image orientation (whether it be portrait or landscape), the spacing between the pels, the spacing between the lines containing the pels and the bit ordering. These attributes are used in reproducing the image and apply to both the Type I and Type II raster data formats.

Type I data is CCITT T.6 encoded data for an entire scan representation enclosed within MIL-STD-1840 header information. The CCITT T.6 encoding of raster data is defined in FIPS PUB 150, Telecommunications: Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus. Type I has no support for tiling, but has the virtue of simplicity.

Type II data is a MIL-STD-1840 header wrapped around an ODA document as specified in the ODA Raster DAP. The ODA document may consist of a single compressed block of data as in Type I or it may be tiled. ODA parameters and data structuring must be included. A discussion of the ODA architecture is included in Section 11 of this summary document.

5.4 STATUS AND PLANNED EXTENSIONS

MIL-R-28002B was published in December 1992. As a result of international harmonization activities, changes were made to the March 1993 version of the ODA Raster DAP. The "application comments" attribute will now consist of two fields to be compatible with other International Profiles and the value for the "ODA version" attribute was changed. DoD decided that these changes were significant enough to warrant an amendment to MIL-R-28002B. The amendment will contain changes to Appendix A (the ODA Raster DAP) and is not expected to impact the MIL-R-28002B implementation of the DAP. Therefore, current implementations of MIL-R-28002B will be upwardly compatible with the amendment. This amendment is expected before the end of the 1993 fiscal year.

The National Institute of Standards and Technology (NIST) is planning to issue the ODA Raster DAP as a FIPS PUB by the end of 1993. Once the FIPS is in place MIL-R-28002 will no longer contain the ODA Raster DAP as an appendix, but will reference the appropriate FIPS.

The ODA Raster DAP published in the September 1992 OIW Stable Implementation Agreements (Appendix A to MIL-R-28002B), was presented to the Profile Alignment Group for ODA (PAGODA) for consideration as an International Profile. PAGODA delegations agreed to propose to the respective workshops that a specification be developed with the intent of achieving a proposed Draft International Standardized Profile (pDISP). In International circles a Profile is called an Open Document Format (FOD). The ODA Raster DAP became pDISP FOD112.

The ODA Raster DAP was widely circulated among the respective workshops and comments were forwarded to the OIW ODA SIG. PAGODA delegations represent the OIW, Asia-Oceania Workshop (AOW), European Workshop for Open Systems (EWOS), and CCITT Study Group VIII. PAGODA has requested that FOD112 allow the 512 tile size default and any other tile size for greater flexibility. This tile size change was made to FOD112, but not to the ODA Raster DAP. Therefore the ODA Raster DAP is now a subset of pDISP FOD112. This profile will be reviewed using the International Profile Progressive Schedule with a June 1994 projected date for becoming an International Profile.

5.5 ADVANTAGES OF CURRENT SPECIFICATION

MIL-R-28002 reflects the intent of OSD to use existing and emerging international standards as the basis for implementation. The ODA standard allows the storage of complex documents containing graphics and textual information and the production of compound documents using facsimile technology. ODA was cited for Type II raster data in an effort to ensure that raster data specification efforts align with evolving international raster imaging standards and promote interoperability with other raster data formats used in the open document architecture standard.

5.6 IMPLEMENTATION ISSUES

The development of Type I data capabilities has been evolving for some time and, consequently, has reached a stabilized state. CALS Test Network (CTN) digital raster data interchange testing for Type I data has aided many present and potential DoD contractors in their efforts to develop hardware and software that are technically capable of accomplishing MIL-R-28002 Type I interchanges. In particular, the CTN Engineering Data Transfer Test with EDMICS using MIL-R-28002 (May 1992) reported that MIL-STD-1840A tapes generated by EDCARS and DSREDS were successfully converted from CALS (MIL-R-28002) to EDMICS native format and visually displayed on EDMICS. In principle, this demonstration supported the viability of tri-service data interoperability via CALS media. CTN has published several test reports that describe Type I testing results for a variety of vendor implementations. NIST has begun Type I conformance test development.

Type II data, on the other hand, is a much newer and more complex environment. ODA implementors maintain that a detailed understanding of the ASN.1 Basic Encoding Rules (required by ODA) is not required to understand MIL-R-28002B Type II. A vendor or user need only implement the Raster DAP not the entire ODA standard to achieve a MIL-R-28002 Type II implementation. Users may employ a library of ASN.1 routines to avoid having to fully understand encodings at the bit or byte level. The National Institute of Standards and Technology (NIST) report NISTIR 5108, "Raster Graphics: A Tutorial and Implementation Guide", is an excellent resource for those needing a better understanding of MIL-R-28002 and how to implement it. This tutorial examines the technical issues facing an implementor of the raster data interchange format.

ANSI/AIIM MS53 1993 is also a useful aid to those attempting to develop ODA implementations.

A system that can receive (read) and output (write) MIL-R-28002B Type I and Type II data, will be considered a compliant CALS implementation. The internal raster data format of the system need not use ODA. Cost comparisons between the implementation of data translators verses designing the system's internal format based on ODA, should be performed to determine what is the best MIL-R-28002B (Type II) implementation strategy for each Navy raster system.

Future systems could be designed based on ODA. Navy managers should carefully assess the offeror's knowledge of and experience with ODA. At a minimum, an implementor would need to have expert knowledge of the following ODA documents to avoid the government expending time and resources in offeror/contractor ODA knowledge and experience development activties:

> NOTE: The 1993 version of ISO 8613 is expected in the very near future, therefore all references to ISO 8613 will become the 1993 version and not the 1989 version.

ISO 8613-1: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 1: Introduction and General Principles.

ISO 8613-2: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 2: Document Structure.

ISO 8613-7: (to be published in 1993), Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 7: Amendment - Tiled Raster Graphics Addendum to ISO 8913, Part 7.

Telecommunication Standards Sector (TSS) Recommendation T.417: 1993, Information Technology - Open Document Architecture (ODA) and Interchange Formats - Raster Graphics Content Architectures.

MIL-R-28002B, 14 December 1992, MILITARY SPECIFICATION, RASTER GRAPHICS REPRESENTATION IN BINARY Format, REQUIREMENTS FOR.

MIL-STD-1840B, MILITARY STANDARD, AUTOMATED INTERCHANGE OF TECHNICAL INFORMATION.
Spielman, F.E., and Sharpe L.H., 1993, Raster Graphics: A Tutorial and Implementation Guide, NISTIR 5108, Computer Systems Laboratory, NIST.

5.7 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

The Electronic Imaging/Compression Committee (C.13.7) of the Association for Information and Image Management (AIIM) has developed a standard, ANSI/AIIM MS53 1993, "Standard Recommended Practice - File Format for Storage and Exchange of Images - Bi-Level Image File Format: Part 1", that specifies a file format for the exchange of bi-level, electronic images. MS53 is considered a subset of the ODA Raster DAP, but it does not allow for the tiling of raster images. This standard has

been developed to encourage the use of ODA by the United States image technology community and to provide a much needed standard bi-level image file format. It is seen as an introductory tool for users and implementors of ODA, ASN.1 and ODA Raster DAP applications requiring MIL-R-28002 Type II untiled data. MS53 is AIIM's attempt at a "cookbook" approach to the exchange c· ᷊ᴵ-level electronic images using ODA with ASN.1 encoding.

The Navy Automated Document Management And Publishing System (ADMAPS) utilizes MIL-R-28002 Type I during the document scanning, raster image display and raster image storage processes.

During 1991 the CALS Test Network evaluated the CALS data interchange utilities developed as a part of the Air Force EDCARS and Navy EDMICS programs. Both systems were found to be capable of importing and exporting CALS MIL-STD-1840 tapes containing MIL-R-28002 Type I image data.

The CTN Raster Test Bed at the Lawrence Livermore National Laboratory (LLNL) and David Taylor Model Basin, CDNSWC have been involved with the testing and validation of raster image data provided by Industry and DOD.

InterLinear Technology, in support of LLNL has developed a Test tool called "ODATOOL" to evaluate CALS raster image data formatted according to the MIL-R-28002A. CTN has tasked InterLinear to update the ODATOOL in accordance with MIL-R-28002B. InterLinear offers commercial products to write, convert and read ODA files. At present only the Modular Electronic Document Information Solution (MEDIS) systems by InterLinear Technology support MIL-R-28002 Type I and II.

5.8 STRUCTURE OF DEVELOPMENT ORGANIZATION

The Computer-aided Acquisition and Logistic Support (CALS) Office of the Department of Defense sought suggestions from the large document raster industry for a standard interchange file format and encoding scheme. An ad-hoc industry Tiling Task Group (TTG) was formed and developed a draft standard based on the Consultative Committee on Telegraph and Telephone (CCITT) Recommendation T.73.

Subsequent to the approval of T.73, CCITT began collaborating with the International Organization for Standardization (ISO) and developed a technology based upon the concept of a compound document which was to replace the current facsimile environment. International Standard (IS) 8613, which defines the Open Document Architecture (ODA), was the result.

The TTG modified its file format into a Document Application Profile (DAP) for ODA and wrote a proposed addendum to ISO 8613, Part 7 - Ra ; Graphics Content

Architectures, in order to insert the minimal mechanisms needed to support tiling. DAPs are developed by groups such as the TTG to satisfy special user requirements.

The development of a DAP specific to image applications has been driven by requirements for the interchange of CCITT facsimile documents and DOD CALS applications for scanned images and engineering drawings. The DAP continues to be further developed by the ODA Special Interest Group (SIG) of the OSI Implementors' Workshop. The ODA Raster DAP, is the result of this group's efforts.

Stable Implementation Agreements for Open Systems Interconnection Protocols: Part 23 ODA Raster DAP, September 1992, is the Raster DAP that is Appendix A of MIL-R-28002B. It is the result of the continuing efforts of the ODA SIG. The development of this DAP was performed in liaison with the DOD CALS Office, David Taylor Model Basin CDNSWC, and the ad-hoc Tiling Task Group.

5.9 REFERENCE AND IMPLEMENTATION DOCUMENTS

1. ANSI/AIIM MS53 1993, "Standard Recommended Practice - File Format for Storage and Exchange of Images - Bi-Level Image File Format: Part 1".

   NOTE: The Consultative Committee on Telegraph and Telephone (CCITT), has changed its name to Telecommunication Standards Sector (TSS).

2. CCITT Recommendation T.503: 1984, Document Application Profile for the Interchange of Group 4 Facsimile Documents.

3. CCITT Recommendation T.6: 1988, Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus.

4. Dawson, F., and F. Nielson, 1990, ODA and Document Interchange, Unix Review, vol. 8, no. 3, March 1990, p.50.

5. FIPS PUB 150: 4 November 1988, Telecommunications: Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus.

6. Gaudette, P., S. Trus, and S. Collins, 1989, The Free Value Tool for ASN.1, Technical Report NCSL/SNA-89/1, National Computer Systems Laboratory, NIST.

7. ISO 8571: 1988, Information processing systems - Open Systems Interconnection - File transfer, access and management.

   NOTE: The 1993 version of ISO 8613 is expected in the very near future, therefore all references to ISO 8613 will become the 1993 version and not the 1989 version.

8. ISO 8613-1: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 1: Introduction and General Principles.

9. ISO 8613-2: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 2: Document Structures.

10. ISO 8613-4: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 4: Document Profile.

11. ISO 8613-5: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 5: Open Document Interchange Format.

12. ISO 8613-7: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 7: Raster Graphics Content Architectures.

13. ISO 8613-1: 1991, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 1: Annex F - A Document Application Profile Proforma and Notation.

14. ISO 8613-7: (to-be-published), Information processing - Text and Office Systems; Office Document Architecture (ODA) and Interchange Format - Part 7: Amendment - tiled Raster Graphics Addendum to ISO 8913, Part 7.

NOTE: The to be published version of ISO 8613-7 will contain the same information as in TSS T.417. These documents are the result of a collaborative effort by ISO and TSS.

15. ISO 8824: 1987, Information Processing Systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1).

16. ISO 8825: 1987, Information Processing Systems - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).

17. ISO 8879: 1986, Information processing - Text and Office Systems - Standard Generalized Markup Language (SGML).

18. ISO 9069: 1988, Information processing - SGML support facilities - SGML Document Interchange Format (SDIF).

19. ISO 9070: 1990, Information processing - SGML support facilities - Registration procedures for public owner identifiers.

20. ISO/IEC International Standard Profile (ISP) 11181-1: 1992, Information technology - Standardized Profile FOD26 - Office Document Format: Enhanced document structure - Character, raster graphics and geometric graphics content architectures - Document Application Profile.

21. ISO/IEC International Standard Profile (ISP) 11182-1: 1992, Information technology - Standardized Profile FOD36 - Office Document Format: Enhanced document structure - Character, raster graphics and geometric content architectures - Document Application Profile.

22. MIL-R-28002B: 1992, MILITARY SPECIFICATION, RASTER GRAPHICS REPRESENTATION IN BINARY FORMAT, REQUIREMENTS FOR.

23. MIL-STD-1840B: 1992, Military Standard, Automated Interchange of Technical Information.

24. Rose, M.T., The Open Book: A Practical Perspective on OSI, Prentice Hall, Englewood Cliffs, NJ., 1990.

25. Sharpe, L., Tiling: Turning Unwieldy Drawings into Neat Little Packets, Inform, Association for Image and Information Management, March 1989.

26. Shuford, A., 1992, Report Comparing MIL-R-28002A Appendix A and Draft MIL-R-28002B Appendix A, CDNSWC/TM-12-92/71, Systems Department Technical Memorandum, David Taylor Model Basin, Carderock Division Naval Surface Warfare Center, Bethesda MD. 20084-5000.

27. Spielman, F.E, and Sharpe, L., 1991, Tiled Raster Graphics and MIL-R-28002A: A Tutorial and Implementation Guide, NISTIR 4567, National Computer Systems Laboratory, NIST.

28. Spielman, F.E., and Sharpe L.H., 1993, Raster Graphics: A Tutorial and Implementation Guide, NISTIR 5108, Computer Systems Laboratory, NIST.

29. Stable Implementation Agreements for Open Systems Interconnection Protocols: Part 23 - ODA Raster DAP, September 1992.

30. Stable Implementation Agreements for Open Systems Interconnection Protocols: Part 23 - ODA Raster DAP, March 1993.

31. Telecommunication Standards Sector (TSS) Recommendation T.417: 1993, Information Technology - Open Document Architecture (ODA) and Interchange Formats - Raster Graphics Content Architectures.

SECTION 6 - DIGITAL REPRESENTATION FOR COMMUNICATION OF ILLUSTRATION DATA: COMPUTER GRAPHICS METAFILE (CGM) - MIL-D-28003

6.1 PURPOSE

The Military specification, MIL-D-28003, "Digital Representation of Illustration Data: Computer Graphics Metafile (CGM)", specifies an application profile of the International and U.S. standards for CGM and certain specific additional requirements. The Computer Graphics Metafile standard (ISO 8632) is a published International Standard (ISO 8632), an American National Standard (ANSI X3.122), and a Federal Information Processing Standard (FIPS 128). The CGM standard is being developed and maintained through a coordinated effort of ISO SC24 and ANSI X3H3. The U.S. and international standards are identical.

The overall intent of the CGM standard is to provide the lowest level of drawing functionality required to capture and reproduce a picture, in a way that is portable across applications and devices. The CGM standard specifies two-dimensional vector graphics data interchange, in a file format that can be created independently of device requirements and translated into formats needed by specific output devices, graphics systems, and computer systems.

A metafile is a device-independent, application-independent storage format for the exchange of the data that makes up a picture ("picture data"). The metafile definition in ISO 8632 includes a definition of output primitives and attributes that may be used to compose an illustration, but in an intentionally under-specified semantics (meaning). This was done to accommodate a wide range of existing systems, and to make the standard more adaptable to the requirements of diverse applications and users. Three CGM encodings meet different needs, but all may be interchanged without loss of information. The binary encoding facilitates rapid graphic data processing. The character encoding is compact and transportable. And the clear text encoding is human readable and editable.

ISO 8632 CGM is an upwardly compatible standard format, developed in three versions that offer steps in capability. Version 1 includes elements of ISO 8632 CGM:1987. Version 2 is also based on ISO 8632:1987, but adds capabilities through Amendment 1:1990. Version 3 incorporates ISO 8632:1987, Amendment 1 and Amendment 3:1991 which has resulted in major increases in capabilities that are represented by ISO/IEC 8632:1992 the current version of the CGM standard. ISO/IEC 8632:1992 provides a clear definition of Version 1, 2 and 3 metafiles.

The CGM application profile specified by Military Specification MIL-D-28003 adopts FIPS 128 and defines additional requirements. MIL-D-28003 defines an application profile for the delivery of two-dimensional picture descriptions of illustration data that are vector or mixed vector and raster, delivered in the digital format of Computer Graphics Metafile. MIL-D-28003, first published 20 December 1988, was superseded by MIL-D-28003A published 15 November 1991. Amendment 1 to MIL-D-28003A was published 14 August 1992.

MIL-D-28003A:

- Includes Version 1, Version 2, and Version 3 of ISO 8632.
- Includes Type 0 (monochrome), Type 1 (grayscale) and Type 2 (full color) all based on DoD usage.
- Defines CGM application profile requirements that address the first of several classes of conforming basic metafiles, a conforming basic metafile generator, and both a minimum-level and a publication-level conforming basic metafile interpreter.
- Specifies requirements on CGM generators and interpreters to provide control over the creation and parsing (validation) of conforming metafiles, and to remove implementation dependencies that might preclude predictable (i.e., unambiguous) interchange of metafiles.
- Defines defaults for interpreters where these are not specified by the standard.
- Limits encodings to binary. Character and clear text are prohibited.
- Uses ISO registered line types (10 additional line types are added as specified in ANSI Y14.2M-1979).
- Uses ISO registered hatch styles (18 additional hatch styles, commonly used in drawings, are added).
- Resolves a common indeterminacy in CGM color usage.
- Corrects known errors in the CGM standard.
- Allows metrically equivalent fonts to be substituted for the Hershey font specified by the CGM standard.

6.2 TYPICAL APPLICATIONS

The MIL-D-28003A is intended for use in computer graphics applications in the following situations:

- A graphics metafile is maintained at a central facility for a decentralized system that employs graphics devices of different makes and models that must utilize the data.
- A graphics metafile is required to preserve picture data when conversion or migration from one graphics system to another is necessary and the two systems are not necessarily compatible.
- A graphics metafile is intended for information interchange between a source system and a target system that are not necessarily compatible.

FIPS 128 in conjunction with MIL-D-28003 should be used when the representation of graphical information in digital form is to be used in technical illustration and publications, and when the use of a general-purpose, graphical interchange mechanism is required.

ISO 8632 CGM is the recommended standard to:

- View the image on a wide variety of devices, with different characteristics (such as color and resolution), where the set of devices may not even be known at the time the metafile is generated;
- Enhance the picture before viewing the final image; and
- Compose or overlay several drawings into a single picture for viewing.

6.3 ARCHITECTURE

The CGM standard (ISO 8632-1987) (FIPS 128), "Computer Graphics Metafile for the Storage and Transfer of Picture Description Information" is composed of 4 parts. MIL-D-28003A utilizes Part 1 and Part 3 of the standard's four part architecture.

Part 1 - Functional Specification - defines the functions of the CGM, independent of any encoding. It also includes responses for the standard and design requirements and design criteria.

Part 2 - Character Encoding - defines an encoding of the Part 1 functionality in a format that conforms to ISO code extension rules. It is intended to provide an encoding of minimum size, and may be used for transfer of pictures through networks that cannot support binary transfer of data.

Part 3 - Binary Encoding - defines an encoding of the Part 1 functionality that is intended to not require any other effort to generate and interpret on many systems.

Part 4 - Clear Text Encoding - specifies an encoding of the Part 1 functionality that can be created, viewed, and edited with standard text editors. This encoding is appropriate for networked systems that support only text file transfer.

6.4 STATUS AND PLANNED EXTENSIONS

MIL-D-28003, first published 20 December 1988, was superseded by MIL-D-28003A published 15 November 1991. Amendment 1 to MIL-D-28003A was published 14 August 1992. MIL-D-28003A provides capabilities that are in keeping with ISO 8632 (FIPS 128). An Amendment 2 to MIL-D-28003A is being proposed by the Industry Steering Group/Drawing and Graphics Committee, that will include metafile descriptions, clarification of restricted text, order of precedence and rules for profiles. The overall intent of this amendment is to permit the majority of CGM software procured under MIL-D-28003 to meet the requirements of MIL-D-28003A.

Due to the close coordination of the U.S. and international CGM standardization efforts, there is a move to make CGM Application Profiles, MIL-D-28003A being one of these, into International Standardization Profiles. If this is approved, the international community will make changes and compromises to the former CGM Application Profiles such as the CALS CGM AP.

As previously stated, ISO/IEC 8632:1992 is the newly published version of the CGM standard and includes capabilities from ISO 8632:1987, Amendment 1 and Amendment 3. In particular, Addendum 3 to ISO 8632 CGM is targeted towards making CGM more applicable to the CALS environment. It includes the following capabilities:

- Advanced 2D graphics (curves; fine control of line appearance; composite line primitives; user defined line types, hatch styles and marker types; additional standardized hatch styles; arbitrary text path; filing mechanism; and general linear transformations).

- Improved text and font support (providing a linkage to the font standard ISO 9541).

- Arbitrary boundaries for clipping and shielding.

- Additional color models beyond RGB (CIE, etc.) are handled through a new value COLOUR MODEL. This is a result of alignment with the ODA Color work.

- Additional raster graphics (scanned image) capabilities were added to the Tile Array to assure it will be able to accommodate all popular industry formats (ODA Part 7, CALS 28002, TIFF, generic CCITT) without forcing serious manipulation of the already-compressed data.

- The functionality of an external reference to "standard" libraries of named symbols is provided.

- A provision for designation of transparent cells in Cell Array, Tile Array, and pattern definition elements is included.

The purpose of this work is to extend CGM to fulfill requirements (especially of CALS) of engineering drawings, the preparation of graphic arts quality presentation materials, cartography, and technical publishing.

The CGM method of tiling is based on the Tiled Raster Interchange Format (TRIF) that has been developed for ISO 8613-7: Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 7: Amendment - Tiled Raster Graphics Addendum to ISO 8913, Part 7. This method is based on the ODA work and is compatible with the ODA Raster DAP in MIL-R-28002B: 1992, MILITARY SPECIFICATION, RASTER GRAPHICS REPRESENTATION IN BINARY FORMAT, REQUIREMENTS FOR. The raster tiling method in CGM is very similar to the method used in MIL-R-28002 and therefore one can easily convert between the two. The addition of tiled raster capabilities, based on the Tiled Raster Interchange Format (TRIF), allows for the encoding of large raster images within a CGM file.

Amendment 4 to ISO 8632 has been proposed to define Rules for Profiles. This amendment includes rules for profiles, a model profile, and conformance requirements. Possible future extensions to CGM of considerable interest to CALS include the formulation of an object structured grammar. This has been requested from, and will be of major use to, CGM users in commercial aviation (intelligent graphics); CALS electronic review (review comments in graphics and stronger links to text); and hypermedia (smart objects in graphics databases). Another possible extension includes an amendment to add "intelligent graphics".

6.5 ADVANTAGES OF CURRENT SPECIFICATION

CGM specifies device-independent, digitally-encoded vector graphics data. CGM files are easily transferred and displayed on a wide variety of hardcopy devices (dot-matrix, ink-jet, electrostatic, and laser printers, pen plotters, and film cameras). CGM files can

also be easily previewed on an extensive range of softcopy terminals. In comparison to Raster, CGM is easily modifiable, generally of much smaller size, and not dependent upon resolution of the output device. In comparison to IGES (2D data), CGM is faster to interpret and display, and again more compact. The selection of which of the CALS graphic standards (raster, IGES, or CGM) that best fits the application, should be the result of the thorough examination of the processes involved in the application.

6.6 IMPLEMENTATION ISSUES

Although MIL-D-28003 has been available for some time, vendors have not fully implemented it, thereby causing confusion among users. Vendors who state they are "CGM-conforming" may not be MIL-D-28003 conforming. Some vendors actually have a problem with importing and exporting the same image; if a CGM file is imported and then immediately exported, it may be changed.

The National Institute of Standards and Technology (NIST) offers two CGM Test services: metafile testing and generator testing. The purpose of the test services is to determine the degree to which the metafile or CGM generator conforms to FIPS 128 and MIL-D-28003. At present, formal validation is available for metafile testing (i.e. instances of CGM) and generator testing. A certificate of validation is issued for metafiles or generator implementations that have been tested and are in compliance with FIPS 128 and MIL-D-28003. CGM interpreter testing is planned to begin at the end of 1993.

CALS Test Network (CTN) has been testing Version 1 CGM interchange for several years, but has only recently acquired a CGM generator library that will permit the construction of Version 2 and Version 3 CGMs. CTN continues to work closely with NIST and the CGM standards organizations to improve the standard and to resolve implementation issues.

The ISO 8632 CGM Amendment 3 draws heavily from the Open Document Architecture (ODA) Colour Addendum. The ODA colour addendum has a second calibration matrix which CGM Amendment 3 has not included. This may cause some inconsistencies when CGM is used as the graphics content of an ODA document.

The OSI Implementors Workshop (OIW) has developed an ODA profile with CGM content. This is identical to Part 8 of the ODA standard. The CGM committee has reviewed this profile and finds it significantly flawed. Several rounds of commenting,

with over twenty major technical problems spelled out, have not sufficiently changed this ODA profile to make it acceptable to the CGM committee.

6.7 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

CGM is an established standard and has successfully been added to the list of input and output formats for off-the-shelf products. There are over 350 implementations on most hardware platforms (i.e, DOS, Windows, UNIX, VMS, Macintosh and OS/2). Portions of the information in Figure 2 were extracted from a graphics connectivity market analysis performed by ImageMark Software Labs, 1990. The majority of the presently available CGM software is based on CGM Version 1.

PRODUCT	MANUFACTURER	IMPORT	EXPORT
Applause II	Ashton-Tate	X	X
Arts & Letters	Computer Support	X	X
CADleaf *	Cadberry Technology		X
Corel Draw	Corel Systems	X	
Designer *	Micrografx	X	X
Draw Applause	Ashton-Tate	X	X
DrawPerfect	WordPerfect	X	
Freelance Plus	Lotus Development	X	X
Forreview *	ATC		X
Graph in the Box	New England Software	X	
Graph Plus	Micrografx	X	X
Graphics Gallery	Hewlett-Parkard	X	X
GRAFPACK-CGM *		X	
GRAFPACK-GKS *		X	
Graphporter *	GSC	X	
Graphwriter II	Lotus Development	X	
Harvard Graphics	Software Publishing	X	X
Interleaf *	Interleaf	X	X
IGES convers. utilities	IDA	X	
Lotus 123 Ver. 3.0	Lotus Development	X	
Manuscript	Lotus Development		X
Metapict *	GSC		X
Mirage	Zenographics	X	
PageMaker	Aldus		X
Pixie	Zenographics	X	X
SuperImage	Computer Associates	X	
Ventura Publisher	Xerox		X
WordPerfect	WordPerfect		X
Output/Translator Application (O/TA)	System One Software	X	X
CTS/Metaview	CGM Technology Software	X	
MDC CGM Toolkit	McDonnell Douglas	X	X

Figure 2 - CGM Vendor Support

The "*" indicates that the vendor claims to support MIL-D-28003, but not MIL-D-28003A.

6.8 STRUCTURE OF DEVELOPMENT ORGANIZATION

The CGM standard is being developed and maintained through a coordinated effort of ISO SC24 and ANSI X3H3, as the U.S. and international standards are identical. In addition, the Drawing and Graphics Committee within the NSIA Industry Steering Group Standards Task Group will be addressing problems and missing functionality of the drawing standards (MIL-D-28003, MIL-R-28002, MIL-D-28000), and recommending additional work to improve those standards.

6.9 REFERENCE AND IMPLEMENTATION DOCUMENTS AVAILABLE

1. ISO 8632, Information Processing Systems - Computer Graphics - Computer Graphics Metafile.

2. Henderson, L. and Mumford, A.: "The Computer Graphics Metafile" Butterworth Series in Computer Graphics Standards.

3. Henderson, L. and Mumford, A.: "Introduction to The Computer Graphics Metafile" Butterworth Series in Computer Graphics Standards.

4. NIST CGM Information Pack for Testing Conformance to the FIPS 128 and CALS CGM Application Profile, NIST.

5. "How the CALS Program Should Utilize Computer Graphics Standards" Final Report, Dr. Peter Bono, October 10, 1986, NBS 43NANB615018.

6. Military Specification MIL-D-28003A, Digital Representation For Communication of Illustration Data: CGM Application Profile (CGM AP).

SECTION 7 - INTERACTIVE ELECTRONIC TECHNICAL MANUAL SPECIFICATIONS

7.1 PURPOSE

Interactive Electronic Technical Manuals (IETMs) are the paperless but functional equivalent of conventional paper-based technical manuals and will, in the future, replace some of those paper TMs in the field. The purpose of these specifications is for the acquisition of IETMs and associated support data bases by a DoD Program Manager. The use of automated access and presentation techniques in IETMs is such that these CALS specifications will not be simple extensions to the paper-based TM specifications but will be a new category of specification as part of the CALS program.

7.2 TYPICAL APPLICATIONS

These specifications will be used in several modes to secure various IETM products such as the revisable source data base for the IETM, the presentation software for the IETM, and the computer readable IETM data package which is the IETM itself.

The Navy is assessing the applicability of IETMs to its A/F-X developmental Advanced Tactical Aircraft, the SPAWAR FDS/IUSS, and to the AEGIS surface ships and their associated weapons systems.

The Air Force is planning to conduct large-scale field evaluations of IETM applicability for the F-16 fighter, JSTARS, the B-2 bomber, and the F-22 Advanced Tactical Fighter Aircraft.

The Army is performing IETM tests on a number of fielded systems, including a Contact Test Set for the M-1 Tank, the Hawk missile radar, the AH-64 helicopter, and the Avenger missile.

The V-22 aircraft Program is planning the use of IETMs and will be a joint effort invloving the Navy, the Marine Corps, and the Air Force.

7.3 ARCHITECTURE

The IETM specification suite consist of the following three IETM Specifications:

a. Military Specification MIL-M-87268. Manual, Interactive Electronic Technical (IETM): General Content, Style, Format, and User Interaction Requirements for. MIL-M-87268 provides a general set of Content, Style, Format, and User-Interaction requirements to be cited in all IETM acquisition actions.

b. Military Specification MIL-D-87269: Data Base, Revisable: Interactive Electronic Technical Manuals, for the Support of. MIL-D-87269 defines requirements for the weapon-system-related data base from which IETMs or View Packages are to be constructed. The data base elements are defined using SGML.

c. Military Specification MIL-Q-87270: Quality Assurance (QA) Program: Interactive Electronic Technical Manuals (IETMs) and Associated Technical Information; Requirements for. MIL-Q-IETMQA defines a Contractor-executed Quality Assurance Program to assure the preparation of high-quality IETMs by prime weapon-system Contractors and their suppliers.

Two additional specifications are needed to support the procurement of an entire IETM system. While the drafts are not ready for coordination at this time, they will include: 1) the hardware and software to be used by the user electronic display system (EDS), and 2) the computer readable View Package (Ref. 5) which is the form of the IETM extracted, compiled, and electronically formatted for direct use (i.e., "read") by the EDS.

The architecture and use of the specifications are, in general, as follows:

1. First the IETM provider must develop a Quality Assurance Program Plan (QAPP) according to the guidance provided in MIL-Q-87270, after which

2. The IETM provider is contracted to build and maintain a revisable IETM Data Base structure conforming to MIL-D-87269 and then loaded with IETM content data conforming to the requirements of the Content and Style sections of MIL-M-87268.

3. The Provider is then tasked to extract, compile, and format an IETM View Package according to a specific View Package Specification which spells out the functional requirement for the IETM as well as the precise format for the View Package.

4. This IETM View Package, copied onto the official distribution medium by the Government, is then provided to the end user who views the IETM on an IETM Electronic Display System (EDS) which must present the IETM information in accordance with the Format and User-Interaction Sections of MIL-M-87268.

7.4 STATUS AND PLANNED EXTENSIONS

The three DoD IETM specifications have been developed and have been issued effective 20 November 1992. The Tri-Service Working Group for IETMs has approved a tentative plan to revise these specifications over the next three years and to develop handbooks and specifications for the View Packages and the Electronic Display System (EDS).

7.5 ADVANTAGES OF CURRENT SPECIFICATION

True integration of DOD weapon-system logistic-support Technical Information (TI) systems, as required by the Computer-Aided Acquisition and Logistics Support (CALS) and Corporate Information Management (CIM) initiatives, would be rendered impossible by the continued reliance of the Services on paper-based Technical Manuals (TMs) for the great bulk of this information. The solution to this dilemma has been to introduce a new type of Technical Manual especially developed for display using the power and convenience of the personal computer.

Recommendations to employ IETMs throughout the DOD are based securely on RDT&E carried out by all three Services during the 1970s and 1980s. User surveys within the DOD, technological analyses, design studies, laboratory experimentation, and operationally realistic tests of IETM principles have been carefully performed. Measurable field results show not only that the great majority of Service technicians find the IETM approaches desirable, but that maintenance performance is significantly improved, particularly in complex areas such as troubleshooting. These test show that the performance of inexperienced technicians shows significant improvement over performance with paper TMs.

7.6 IMPLEMENTATION ISSUES

These IETM Specifications are the first in a series needed for full IETM implementations. Although the technology required for adoption of IETMs exists today, full exploitation of the IETM capability requires resolution of a number of technical problems over the next few years. Examples of such technical issues are:

a. A standardized tri-Service definition of user-interaction (man-machine) features most useful for IETMs.

b. Improved automation of processes for authoring IETMs.

c. Improved techniques for Government IETM acceptance testing.

d. Improved computer-controlled fault-isolation processes.

e. Improved screen display of large-scale drawings and schematics.

However, the most pressing issue is the need for a coordinated DOD IETM implementation strategy to assure Service-wide acquisition and effective use of the IETM technology. Such a Strategy should incorporate the following components:

a. Establishment of Service policies for IETMs

b. Identification of requirements for an IETM Acquisition and Support System

c. Designation of organizational responsibility for IETM acquisition and control

d. Plan for transition from paper TMs to IETMs

e. Establishment of support RDT&E programs

f. Continued improvement of IETM Specifications and Standards

g. Coordination of existing IETM efforts in the Services

h. Coordination of IETM technology and support systems with other DOD Technical Information systems.

7.7 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

The IETM Specifications have been widely distributed among Industry and have been briefed at CALS conferences and IETM Working Group meetings. All three Services, as well as the CALS Standards Industry Task Group, have contributed comments on the specifications. Several large Military Suppliers have developed IR&D programs to support IETMs. In the past there have been few commercial products to support the Specifications, however, with the formal release of the Specifications late in 1992, suppliers of IETM authoring and presentation products and support are expected to greatly increase in the very near future. Bridge products (i.e., migration aids from paper-based publishing systems to IETMs) will also emerge in the form of modified Hyper-Text viewing software and add-on products to conventional automated publishing systems to output SGML-tagged files with IETMDB (i.e., MIL-D-87269) tagged data.

7.8 STRUCTURE OF DEVELOPMENT ORGANIZATION

The CALS specifications for IETMs have been developed by the Tri-Service Working Group for Interactive Electronic Technical Manuals, chartered by the OSD CALS Office. The David Taylor Model Basin, Carderock Division Headquarters, Naval Surface

Warfare Center, (CARDEROCK DIV NAVSURFWARCEN) is the Navy's Lead Laboratory for Technical Manual Automation and is the chair of the Tri-Services Working Group on IETMs. DTMB serves as the primary contact with the Industry CALS committees relating to Automated Technical Manuals and was the creator of the initial set of draft specifications for IETMs. DTMB is leading this effort with assistance from the Air Force (AFMC/ENC) and Army (LOGSA) Members of the Tri-Service IETM Working Group.

7.9 REFERENCE AND IMPLEMENTATION DOCUMENTS AVAILABLE

1. Military Specification MIL-M-87268. Manual, Interactive Electronic Technical (IETM): General Content, Style, Format, and User Interaction Requirements for. Tri-Service Working Group for IETMs. 20 November 1992.

2. Military Specification MIL-D-87269: Data Base, Revisable: Interactive Electronic Technical Manuals, for the Support. Tri-Service Working Group For IETMs. 20 November 1992.

3. Military Specification MIL-Q-87270: Quality Assurance (QA) Program: Interactive Electronic Technical Manuals (IETMs) and Associated Technical Information; Requirements for. Tri-Service Working Group for IETMs. 20 November 1992.

4. Jorgensen, Eric L. Draft Handbook MIL-HDBK-EDS(NAVY): Electronic Display System for Navy Interactive Electronic Technical Manuals. David Taylor Research Center. DTRC/TM-12-91/11. July 1991.

5. Jorgensen, Eric L. Draft Handbook MIL-HDBK-IETMVP: Preparation of View Packages in Support of Interactive Electronic Technical Manuals. DTRC/AFLC/AFHRL. CDNSWC/TM-12-92/84. July 1992.

SECTION 8 - HYPERMEDIA TIME-BASED DOCUMENT STRUCTURING LANGUAGE - HYTIME (ISO/IEC Draft International Standard 10744)

8.1 PURPOSE

The Hypermedia Time-Based Document Structuring Language (HyTime) is a standard language for representing the logical structure of documents with requirements for space and time based coordinates and addressing. HyTime is based on SGML (ISO 8879), and uses the grammatical and syntactical conventions of SGML. HyTime provides the capability to package information objects using a standardized markup language whose structure will enable non-sequential access, querying, version control, and long-term maintenance despite system evolution or migration.

By using the SGML/HyTime standards, the application designer can create system independent files that are transferable and interoperable across dissimilar computer applications. HyTime provides architectural forms for the definition of SGML element classes in SGML Document Type Definitions (DTDs). HyTime does not provide a DTD, as such, but instead, constitutes a meta-DTD from which conforming application DTDs can be created.

HyTime is not now a CALS standard. It is perceived as a potential standard supporting future interactive, electronic, hypertext and multi-media CALS applications.

8.2 TYPICAL APPLICATIONS

The HyTime language can be directly applied to hypertext (documents that enable multiple access paths) and multimedia applications. These include the design and encoding of information for Interactive Electronic Technical Manuals and Portable Maintenance Aids (IETM/PMAs), online review of existing documents both in and not in neutral formats, and the creation of large interoperable hyperdocument libraries or design data bases.

HyTime has potential applications in the areas of project management, enterprise process design, discrete event simulation, and music.

8.3 FEATURES

HyTime is designed for modular application. Features of the language which are not needed for an application need not be supported. Depending on which features are supported, HyTime provides:

- Location addressing: a standard way of encoding a stem-neutral address of any information object or any part of an information object within or external to any given document. Addressing may be by name, position, or semantic property.

- Hyperlinking: models for hyperlink classes independent of the number of objects linked to, and the context of the link. One model even provides for attaching properties to information objects that cannot be modified or over-written.

- Scheduling: synchronization and alignment of information objects relative to one another. Information objects are positioned within events on the spatio-temporal axes of a finite coordinate space (FCS). The axes of the FCS can be related and can be named to match the context of the application. For example, the X axis can represent a virtual time line as seen in a project management schedule for project phases, and the Y axis can represent the real clock time as seen by a calendar.

- Object Modification: Object modification is scheduled by HyTime but must be applied by application-specific functions. This enables the scheduling of rendering instructions in other notations, e.g., PostScript.

- Event Projection: Events may be scheduled and projected onto alternative finite coordinate systems and scaled accordingly. For example, if a graphic in a document must be rendered in a smaller area on a display screen, this projection and scaling can be indicated by HyTime notation.

- Parseability: HyTime documents are parseable by SGML applications; parsing checks for correct SGML grammar and syntax as well as conformance of the instance to the DTD.

8.4 HYTIME ARCHITECTURE AND MODULES

The modules of HyTime are:

- Base Module: includes hyperdocument management facilities, SGML, identification facilities for replacing HyTime-specific identifiers with user-defined identifiers with provisions for name collisions, coordinate addressing for scheduling dimensions, positions of events, and document locations addressing by position. There is optional support for specifying activity tracking policies by an activity tracking attribute that is part of the SGML document, and for other basic utilities used to declare default attribute values and definition tables.

- Location Address Module: includes functionality to provide addressing of information objects without a unique identifier within the current document's name space. Supports addressing by coordinate location (discrete dimensions of arbitrary universe), semantic location (by SGML attribute name or by notation-specific address), or namespace location (SGML entities and SGML elements in external documents).

- Hyperlink Module: Uses five metaclasses of hyperlinks to define application-specific hyperlink elements with their own processing semantics. The link classes are:

  - independent links can have any number of link ends with optional end terms used as text or icons to invoke the link,

  - property links (two link ends which associate an attribute name and value with an element),

  - contextual links (two link ends, one of which is a link's own location),

  - aggregate location links link multiple locations and treat them as a single location,

  - span links allow contiguous information to appear to be undivided by SGML markup.

- Finite Coordinate Space Module (FCS): provides for scheduling of objects with optional projection and modification modules. Event schedules define the position and occurrence of objects. Objects occur in an FCS as the content of an event. An event is a conceptual bounding box. Each event has a set of dimension specifications for its position and extent on the coordinate axes of the FCS in which the event schedule appears. The FCS coordinates can be expressed in the terms of the application. Finite Coordinate Spaces can be nested. For example, if a project schedule is modeled as processes nested within processes, the FCS can be used to encode this nesting, the relationship of time changes that occur within a process and the effect of these changes on processes within which it is nested.

8.5 ADVANTAGES OF CURRENT SPECIFICATION

Users of HyTime-compliant systems can incorporate active references within documents and to external online documents. This includes referencing to non-HyTime documents. HyTime can reference documents in multiple notation languages, e.g., IGES, VHDL, ODA, etc. HyTime location addressing includes the capability to reference read-only documents which is crucial to incorporating legacy data.

HyTime provides a standard way to represent abstract time dependencies. HyTime's representation of time and space measurements is the same and can be extended to any measurement domain with any number of axes.

HyTime does not restrict the potential sets of applications nor the application design except in the agreements about how to express hyperlinks. This enables maximum interoperability of hyperdocuments without attempting to standardize the information object notations or modifiers.

8.6 ENHANCEMENTS TO THE PUBLISHED STANDARD

The newest and most significant addition to between the HyTime published standard is the HyQ query language. It was added to provide an alternative user interface (sanctioned by ISO) not only to HyTime and SGML documents but non-SGML documents as well by using HyTime features. Some of the recent technical changes to the published standard impact the Content Data Model which must be revised accordingly.

8.7 IMPLEMENTATION ISSUES

Non-HyTime notations used in scaling factors cannot be executed by a HyTime system. Such notations might include the potential for asynchronous interrupts by a user.

HyTime has been created by the ISO X3V1.8M committee with much effort and time spent anticipating conceivable applications. However, at this time, there are no full scale commercial applications that can be examined to determine if the standard is effective. Some vendors are currently working toward incorporating HyTime features, but as of yet, even simple applications have not been shown publicly. (TechnoTeacher Inc. demonstrated a HyTime system at the Graphics Communication Association (GCA) Winter TechDoc '92). The draft standard is new and no automated validating HyTime engines exist. Most of the examples in the literature have been created by volunteers.

8.8 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

Prominent work being done with the HyTime standard includes that being performed by the Tri-Service working group developing specifications for an Interactive Electronic Technical Manual (IETM), use of the HyTime hyperlinking architectural forms in the Content Data Model of the Integrated Maintenance Information System of the US Air Force, work by the MHEG committee to demonstrate the inclusion of compressed video in a HyTime-compliant document, and the use of the Document Style Semantics and Specification Language (DSSSL) to provide processing semantics for HyTime-compliant applications.

A Special Interest Group (SIG) was created to support the hypermedia community. The SGML SIGHyper: SGML User's Group Special Interest Group on Hypertext and Multimedia is chaired by Steven R. Newcomb, Vice-Chairman of the original ISO committee that created the HyTime standard. SIGHyper maintains an active membership comprised of some of the world's leading authorities in the hypermedia field, and publishes a newsletter containing articles on the use of HyTime.

There are groups studying HyTime. These include the HyTime Study Group at Washington School of Medicine and the CCITT Study Group VIII Working Party 4: Document Architecture, Transfer and Manipulation.

Workshops and seminars on HyTime are being conducted. Techno-Teacher Inc. of Tallahassee, Fla conducted the HyTime Implementer's Workshop at the GCA TechDoc Winter '92 conference in Ft. Lauderdale, Fla. Steven DeRose of Electronic Book Technologies presented the draft HyTime standard at the Hypertext '91 Conference in San Antonio, Texas.

The Davenport Group in their Draft Advisory Standard, 30 January 1992, has adapted a subset of HyTime architectural forms as the basis for Online and Printed Technical Documents (MANPAGES) usually supplied by UNIX vendors to customers. It will allow vendors to bundle documents from a variety of publishers and to give the customers access to these documents via one or more independently defined interfaces.

8.9 REFERENCE MATERIAL

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ISO 8879 Information Processing Standards - Text and Office Systems - Standard Generalized Markup Language (SGML).

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"Standard Music Description Language (SMDL)", Charles F. Goldfarb. Committe Draft International Standard ISO/IEC CD 10743, April 1 1991.

"HyTime: A Standard for Structured Hypermedia Interchange", Charles F. Goldfarb. CALS Journal, Summer 1992, Vol. 1, No. 2.

SECTION 9 - EDIF (ELECTRONIC DESIGN INTERCHANGE FORMAT)

9.1 PURPOSE

The Electronic Design Interchange Format (EDIF) standard (ANSI/EIA 548) is a file format and product description for electrical/ electronic application data files.

EDIF was developed by the Electronic Industries Association (EIA) to attack a pervasive problem: the excessive diversion of CAD engineering manpower in order to exchange design data between diverse CAD hardware and software. It was estimated that this diversion took as much as 60% of a project's work force. Each interface to other CAD systems and tools had to be carefully investigated, and perhaps changed, each time:

- a software tool was upgraded by a vendor,
- an operating system was changed, or
- a different work station was used.

This investigation had to be followed by meticulous testing to ensure that the interface continued to work properly. Also, each time a user obtained a new CAD package, its interfaces to existing tools and host computers had to be carefully checked out and maintained.

EDIF is a neutral electronic design interchange data format. With the use of EDIF only one version of a design library must be written, and only one translator - to a neutral format - is required. EDIF was designed to address all concerns shared by the electronic design community, including simulation models, schematics, and IC layouts.

9.2 TYPICAL APPLICATIONS

Integrated Circuit (IC) vendors use EDIF to exchange IC mask data. In addition, EDIF is used for product representation. There are some users of EDIF for PCB library and layout archive and transfer.

Many EDIF users plan to use VHDL for system architectural descriptions, while proposing to convert the VHDL gate level descriptions into EDIF. This conversion creates a link from the higher-level descriptions to the lower, more physical, descriptions. In fact, some think that EDIF, through its Behavioral View (which describes system behavior), can be used to transform models written in a hardware description language such as VHDL, into an equivalent description in another language.

9.3 ARCHITECTURE

EDIF features and keywords support both the design and the manufacture of electronic systems. EDIF files may be made up of 10 distinct "views" to describe the different electronic design representations:

- Schematic View - drawings of circuits.
- Netlist View - interconnections among components.
- PCBLayout View - physical locations of components and interconnects on each layer of a printed-circuit board.
- MASKLayout View - solder mask.
- Symbolic View - cell outlines on IC layouts.
- LogicModel View - behavior of simple gates.
- Behavioral View - system behavior.
- Graphic View - logos and other simple graphics.
- Document View - user manuals.
- Stranger View - experimental descriptions for cases where the other views are not appropriate.

EDIF files must be:

- computer-comprehensible
- hardware vendor-independent
- non-proprietary
- easily extended and parsed
- human-readable, for debugging

EDIF files are designed to be hierarchical data structures, made up of cells. Within a cell, a view must be able to include representations of other views (e.g., a Document View might contain a description of a cell that is defined in a Schematic View.)

9.4 STATUS AND PLANNED EXTENSIONS

EDIF V2.1.0 is now available from the Electronic Industries Association. This version shows work by the Technical Committee and Subcommittees in the Schematic, PCB, Test and Information modeling areas and is expected to broaden EDIF design data transfer effectiveness. EDIF V2.2.0 and V2.3.0 will cover PCB and Test respectively.

An EDIF EXPRESS information model is also under development. Version 3.0.0 is planned to contain more Behavioral View enhancements and extensions to microwave design.

The Electronic Industries Association (EIA) Ad Hoc CALS Study Group reviewed EDIF, along with VHDL, IGES, and IPC, and tabulated the information elements into four types:

- Behavioral Description
- Functional Description
- Logical Description
- Circuit Definition

These elements were used to determine any overlap between the standards.

EDIF was recommended to be used in the following areas:

- Common data elements
- Circuit Performance Description
- Component Manufacturing Description
- Component General Specification

These areas will be added to MIL-STD-1840 and MIL-HDBK-59.

The CALS office has also determined that the drawings required by DoD-STD-100 (Drawing, Engineering and Associated Lists) map easily onto the database defined by EDIF. The CALS office cites the following EIA documents that relate to EDIF:

- Introduction of EDIF (EIA/EDIF-1)
- EDIF Schematic User Guide (EIA/EDIF-2)

A Microwave Technical Subcommittee is proposing a Microwave View, enabling microwave Computer-Aided Design (CAD) tools to exchange design data. Another Technical Subcommittee is looking at a Computer-Aided Software Engineering (CASE) View. The Test Technical Subcommittee is extending EDIF into analog testing, and EDIF is being mapped to PDES/STEP.

9.5 ADVANTAGES OF CURRENT SPECIFICATION

A major advantage of EDIF over many CAD formats is that EDIF may be used to exchange only the amount of data necessary and agreed upon. Thus, a netlist might be defined in EDIF and sent to an IC foundry. The IC foundry might return an EDIF file describing the resulting IC layout. The users are not obligated to interchange schematic information or behavioral information if not desired.

Traditional IC layout exchange standards (including IGES) describe geometric data, but they do not specify the connectivity between components. EDIF provides an option for describing the connectivity as an integral part of the MaskLayout View.

9.6 IMPLEMENTATION ISSUES

A limitation of EDIF is that it fails to recognize that electrical products are ultimately constructed of mechanical objects. EDIF is the least mature of all product data representation specifications, and is not integrated with the IPC Series 350, VHDL, and IGES at this time.

9.7 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

EDIF has gained wide industry acceptance within specific application domains. In 1988, at the International Conference on Computer Aided Design, two major electronic design work station vendors -- Hewlett-Packard and Valid Logic Systems -- demonstrated systems loaded with schematic capture programs and other software that supported a common EDIF file to handle schematic exchanges.

At the Design Automation Conference in 1988, six CAD systems demonstrated EDIF to over 2000 engineers. Schematics on one workstation were broadcast to the others. The EDIF User's group point of contact is Mr. Suresh Agrawal (214/997-2055).

The EDIF standard is being mapped to PDES/STEP. The PDES/STEP activity is developing PDES Application Protocols for Electronics that include a teaming of the CAD Framework Initiative (CFI), EDIF, and PDES, to facilitate CAD integration through product data. An integrated CAD shared Product Database will be formed. The EDIF responsibilities to this effort are:

- Definition of broad electronic user information requirements
- Mapping of information requirements to EDIF syntax
- Extension of EDIF syntax to support information requirements
- User demonstrations

CFI will be defining, designing, and prototyping a framework for CAD integration, while PDES, Inc. will be defining broad mechanical user information requirements, and refining electronic user information requirements for specific domains (e.g., PCA/PCB). These will subsequently be mapped to STEP.

The Navy's RAMP program is providing a translator that converts the schematic information from EDIF format into an MIL-STD-1840-conforming RAMP fileset. EDIF is used to carry not only the circuit schematic, but also the electrical functionality for passive components (such as resistors, inductors, and capacitors).

A PCB application guide has been published and experimental use of EDIF for PCB library and layout archive and transfer has been started. Interchange of schematics in EDIF among multiple competing vendor systems has been demonstrated twice (at the 1988 Design Automation Conference and at the Fourth EDIF Workshop September 1988). Netlist and schematic transfer in EDIF are common today due to vendor support.

9.8 STRUCTURE OF DEVELOPMENT ORGANIZATION

EDIF is being developed and maintained by the Electronic Industries Association (EIA) Technical Committee. It was originally developed by engineers representing three integrated circuit companies (National, Motorola and Texas Instruments); three CAE systems houses (Daisy Systems, Mentor Graphics and Hewlett-Packard); and the University of California at Berkeley.

9.9 REFERENCE AND IMPLEMENTATION DOCUMENTS AVAILABLE

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*9. "Harmonizing CALS Product Data Description Standards: An Evaluation Report by the EIA Ad Hoc CALS Study Group".

*10. EDIF Standard EIA - 548.

*11. Introduction to EDIF (EIA/EDIF-1).

*12. EDIF Connectivity.

*13. EDIF Application Guide - for Schematics Transfer.

*14. EDIF Schematic User Guide (EIA/EDIF-2).

* Copies of references 9 through 14 may be ordered from the Electronic Industries Association, 2001 Pennsylvania Ave., N.W., Washington, DC 20006 (Mark V. Rosenker, EIA Engineering Department 202/457-4900).

SECTION 10 - VHSIC HARDWARE DESCRIPTION LANGUAGE (VHDL) ANSI/IEEE 1076

10.1 PURPOSE

The Very High Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL) is the most widely used hardware definition language. Though a formal notation, it is both machine readable and human readable, and it supports the development, verification, synthesis, and testing of hardware designs; the communication of hardware design data; and the maintenance, modification, and procurement of hardware. VHDL is a generalized, system-independent language; designs described in VHDL can be interchanged between computer systems that meet the specifications of the standard.

Just as a schematic is initially a design tool but may later function as supporting documentation for the product, VHDL is primarily a design language; its use as an interchange format is a secondary benefit from this goal.

VHDL describes three different "views" of the model being designed: (1) the behavioral view - an algorithmic description of the model (like a programming language); (2) the structural view - a simple netlist description of the component; and (3) the data flow view - a network of signals and transformers.

10.2 TYPICAL APPLICATIONS

VHDL provides a means to design, document, interchange, simulate and debug chip and circuit designs in a non-proprietary way. VHDL is typically used for top down system design, full custom chip design, Application-Specific Integrated Circuits (ASIC) library development, Programmable Logic Design (PLD), Field-Programmable Gate Arrays (FPGA) design, validation of designs before and after synthesis, and development and debugging of model code.

As an example, Intel Corporation is in the process of selecting a suite of VHDL design and synthesis tools for development of the X86 class of chips and other advanced devices.

10.3 SCOPE OF THE STANDARD

Modeled on the Ada programming language, the VHDL standard is made up of the following sections:

- Design Entities and Configurations: The design entity is the primary hardware abstraction in VHDL. It represents a portion of a hardware design that has well-defined inputs and outputs and performs a well-defined function. A configuration can be used to describe how design entities are put together to form a complete design.

- Subprograms and packages: Subprograms define algorithms for computing values or exhibiting behavior. Packages provide a means of defining these and other resources in a way that allows different design units to share the same declarations. Since VHDL has no "goto" construct, subprograms can return to the calling program from any point in their execution (loops may also be exited at any point).

- Types: A type is characterized by a set of values and a set of operations. VHDL provides for strong typing, assuring that the data will be operated on only in predetermined ways.

- Declarations: For each form of declaration, the language rules define a certain region of text called the scope of the declaration. Each form of declaration associates an identifier with a declared entity. Only within its scope, there are places where it is possible to use the identifier to refer to the associated declared entity; these places are defined by the visibility rules.

- Specifications: Specifications may be used to associate additional information with a VHDL description (a previously declared entity).

- Names: Names can denote declared entities, whether declared explicitly or implicitly; objects denoted by access values; subelements or slices of composite objects; and values and attributes of these items.

- Expressions: An expression is a formula that defines the computation of a value.

- Sequential Statements: The various forms of sequential statements are used to define algorithms for the execution of a subprogram or process; they execute in the order in which they appear.

- Concurrent Statements: Concurrent statements are used to define interconnected blocks and processes that jointly describe the overall behavior or structure of a design. Concurrent statements execute synchronously with respect to each other.

- Scope and Visibility: There are rules defining the scope of declarations and rules that define which identifiers are visible at various points in the text of the description.

- Design Units and Their Analysis: The overall organization of descriptions, as well as their analysis and subsequent definition in a design library, is built on design units.

- Elaboration and Execution: The process by which a declaration achieves its effect is called the elaboration of the declaration. After its elaboration, a declaration is said to be elaborated.

- Lexical Elements: The text of a description consists of one or more design files. The text of a design file is a sequence of lexical elements, each composed of characters.

- Predefined Language Environment: There is a predefined environment for VHDL made up of predefined attributes and packages that all VHDL implementations must provide.

10.4 STATUS AND PLANNED EXTENSIONS

VHDL was initially adopted as IEEE standard 1076 in 1987. IEEE requires the revoting of all standards every five years, so in 1990 the IEEE P1076 standards group began identifying a restandard-ization effort. A new version of VHDL (1992) was developed, including all design requirements and as many design goals as possible. VHDL 1992 will be submitted to the IEEE Standards Board in 1993 for approval. New features of VHDL '92 are:

- Deferred Interface Object Mapping - configuration-binding of instance's ports.
- Direct Instantiation - for design entity, configuration declaration.
- Extended Character Set - 8-bit, Roman alphabets.
- Extended Identifiers - allows any printing character, case sensitive.
- Foreign Language Interface - allows access to any architecture or subprogram.
- Generalized Aliasing - anything named can have an alias.
- Groups - used to express and annotate relationships.
- Hierarchical Pathnames - used for assertions, error messages, tool navigation.
- Impure Functions - can access global signals and variables with different arguments, return value.
- Postponed Processes - execute just before time changes so value is stable at current simulated time.
- Pulse Rejection - inertial delay is defined different from transport delay.
- Regularized Syntax - one rule for bracketing keywords.
- Revamped File I/O - can be opened, closed, read from, written to, appended to; not upwardly compatible from VHDL 1987.
- Shared Variables - accessible from multiple processes.
- Shift and Rotate Operators - may be overloaded, assume MSB is sign bit, predefined for arrays of bit or Boolean.

Requested Features not in VHDL '92 are:

- Extensions for analog modeling
- Language support for network-based calculations - load- or fanout-based delay calculations

- Tool-specific semantics - synthesis semantics
- Variant records
- Timing model extensions (FIFOs)
- Asynchronous process reset
- Unconstrained subelements of composite types
- User-defined, single-valued attributes
- Private types and a pseudo-random number generator.

More information about the features of VHDL '92 and those requested but not incorporated may be found in "An Introduction to VHDL" by Paul J. Menchini EDA Consultancy, 2 Davis Drive, P.O. Box 13036, Research Triangle Park, NC 27709-3036.

Five additional projects have been proposed for approval by IEEE:

- 1076.1 analog extensions
- 1076.2 standard math package
- 1076.3 standard synthesis package
- 1076.4 standard timing methodology
- 1076.5 VHDL Utility Library

An official IEEE interpretations documents has been issued "Sense of the VASG" to discuss user-created issues and their resolutions. There is also interest in extending VHDL to allow for the formal verification of designs. The VASG is working together with the chairman of the IEEE Design Automation Standards Subcommittee to determine what work is necessary for this.

Under the Electrical/Electronic project of the PDES,Inc. and the National Initiative for Product Data Exchange, there is an activity to develop STEP Applications that can represent, exchange, and use information for test, integrated diagnostics, and re-manufacture of printed circuit assemblies and line replaceable modules. VHDL and EDIF will be used to perform demonstrations of the developed models with CAD and tester environments and platforms.

Other VHDL activities within the National Initiative for Product Data Exchange include maintenance and enhancement of the standard modeling language.

Extensions to VHDL currently underway are:

- a VHDL information model,
- a standard for the VHDL Intermediate Form
- a standard for VHDL model interoperability
- a standard interface between VHDL and the Electronic Design Interchange Format (EDIF).

Also within the VHDL framework are various test language specifications including WAVES, FDL, and TRSL. WAVES is an IEEE approved test language which provides a standard representation for stimulus and response data in support of the design and

test of digital devices. Related to WAVES is the proposed IEEE Fault, Detection, and Localization (FDL) and the Test Requirements and Specification Language (TRSL). FDL will provide a standard representation of the diagnostic information for digital units needed in the test and design automation environment. TSRL will provide a standard representation for the test requirements and the test intents information needed in the design and test automation process.

Other IEEE VHDL efforts include:

- Data Book - define an electronic data book capturing component information in support of VHDL usage.
- EDIF Interoperability - ensure that VHDL and EDIF are able to interoperate at the Schematic and Netlist Level.
- Timing Study - develop a uniform way to represent timing at the "Network Level" in VHDL models so back annotation can be done in a standard way.

10.5 ADVANTAGES OF CURRENT SPECIFICATION

VHDL is:

- A standard, unambiguous, simulatable description of all parts of electronic designs.
- A technology-independent way to use functional descriptions and automatically synthesize new devices.
- A method for allowing verification of a design through simulation, prior to building expensive hardware.

The DoD sees the documentation of VHSIC designs as a main protection against diminishing manufacturing sources. This same documentation will be used to generate test system software.

10.6 IMPLEMENTATION ISSUES

The 1987 version of VHDL is in wide use. However, the 1992 VHDL is NOT *restricted* to upwards-compatibility to the 1987 VHDL. This poses problems for users who wish to upgrade; it also poses problems with the VASG, who must maintain the older version for some time.

The lack of availability of software to provide formal verification of circuit designs has been a problem. Formal verification consists of a variety of mathematical techniques for specifying and verifying circuit designs. The only commercial product available is limited to the verification of the functional equivalency of synthesized synchronous VHDL designs to the original VHDL description. In order for this standard to be used

effectively for CALS interchange, a more comprehensive verification process must be established.

The VHDL Initiative Toward ASIC Libraries (VITAL) Model Development Specification (Draft), Version 2.0, was developed to promote the rapid development and use of ASIC libraries for VHDL design. Developed by ASIC vendors, CAE tool vendors, and ASIC designers, the spec addresses this group's highest priority issues: timing accuracy, model maintainability, and simulation performance. The specs include an appendix that proposes language changes that would significantly aid in developing models and providing a more concise description of certain classes of designs, as well as aiding in the description and handling of timing information. The proposed changes are:

- Definition of a modified PROCESS Design Unit - support for truth tables and state tables.
- Allow dynamic indices in Event and Last_Value for composite types
- Glitch Detection and X generation
- Previous_Event attribute - to help determine the time since the last event
- Implicit Timing Model - standardizes the way timing is represented for ASIC modeling.

10.7 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

The 1987 version of VHDL is widely used, and the standardization efforts have been supported not only in the U.S., but also in Europe and the Pacific Rim. In June 1991, leading CAD vendors formed the VHDL International Alliance to promote VHDL as a standard. The formation of this alliance shows strong support for the VHDL standard from many of the major vendors.

Most vendors do not fully implement the complete standard, but only a subset of the standard. This can cause problems with interchange, but these discrepancies are being overcome by most vendors as they approach full support of the standard.

A design done in VHDL will include functional blocks that must be mapped to physical components; this implies an interface with EDIF, IGES and IPC. The Electronic Industries Association (EIA) Ad Hoc CALS Study Group studied VHDL along with EDIF, IPC, and IGES and recommended the use of VHDL for Digital Functional Descriptions and for System and Box General Specifications. The CALS office also cites the following industry application protocols:

- Commercial Component Model Specification (EIA)
- Blank Detailed Specification (EIA)
- Timing Module Specification (EIA)
- Engineering practices for the Quality Assurance of Standard Part Models from external Sources (EIA).

MIL-STD-454, which contains standard general requirements for Electronic Equipment (Requirement 64), calls for VHDL model delivery for Microelectronic Devices.

The VHDL Technology Group has developed a VHDL developers toolkit that runs on all the major VHDL simulators. This provides a common modeling style that guarantees high quality VHDL models. In addition, they were selected by VHDL International to develop a vendor-neutral test suite that addresses language compliance and transportability issues. The test suite should be available early 1994.

Appendix A of MIL-STD-1840B contains requirements for VHDL and describes the format and content preparation instructions to be used with VHDL data. This appendix is a normative part of the standard. It includes the detailed requirements for device design and test documentation, and gives the documentation format required. The data packages to be included in the VHDL data file consist of common product description elements, behavioral descriptions of digital electronics, logical descriptions of digital electronics, and timing descriptions. MIL-STD-1840B also calls out the industry application protocol EIA-AP-2229 - Commercial Component Model Specification.

10.8 STRUCTURE OF DEVELOPMENT ORGANIZATION

VHDL was initially adopted as IEEE standard 1076 in 1987. The VHDL developers, the VHDL Analysis and Standardization Group (VASG), a working group of the IEEE Computer Society, then became a maintenance organization. VASG created an Issues Screening and Analysis Committee (ISAC) for maintenance problems; they identified approximately 250 issues and resolved 80 of them. Also, a 1992 Steering Committee was formed, for the next version of VHDL. The Steering Committee was broken into five subcommittees: Design Requirements, Design Objectives, Language Design, Language Documentation, and Language Validation.

With the standardization of VHDL 1992 (in 1993), a new committee will take the place of the 1992 Steering Committee. This new committee will be named the Core VHDL Oversight Committee (note "Core" as opposed to extensions to the language). This committee will be responsible for deciding how and when to deal with the design objectives left over from the 1992 standardization effort, and will also continue restandardization efforts.

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8. The IEEE Standard VHDL Language Refinement Rationale - explains the reasons for the adopted changes, compared to VHDL 7.2 and compared to other changes that were proposed but not adopted. Available from Wright Aeronautical Laboratories.

9. The IEEE Standard VHDL Tutorial - makes extensive use of real examples to present the language in terms of its relevance to hardware design problems. Also illustrates how information expressed in EDIF can be represented within VHDL. Available from Wright Aeronautical Laboratories.

10. The VHDL User's Manual - contains a VHDL tutorial, a VHDL reference guide, examples of benchmarks coded in VHDL, and a set of usage scenarios showing ways in which the VHDL system may be employed to perform a variety of functions. Available from Wright Aeronautical Laboratories.

11. The VHDL Design Analysis and Justification - discusses key language design decisions and justifies the choices made. Discusses similarities and differences between Ada and VHDL. Available from Wright Aeronautical Laboratories.

12. IEEE Standard VHDL Language Reference Manual, IEEE Std 1076-1987.Available from the IEEE, New York, NY.

13. IEEE Standards Interpretations: IEEE Std 1076-1987, IEEE Standard VHDL Language Reference Manual, IEEE Std 1076/INT-1991. Available from the IEEE, New York, NY.

14. Draft Standard VHDL Language Reference Manual, IEEE P1076-1992/B. Available from the IEEE, New York, NY.

SECTION 11 - OPEN DOCUMENT ARCHITECTURE (ODA)

11.1 PURPOSE

11.1.1 Overall Purpose of the Standard

The Open Document Architecture (ODA) standard (ISO 8613) was developed to facilitate the interchange of structured office documents (e.g., letters, memos, reports) among various devices and applications by defining the structure (i.e., layout) and content of documents in an OSI interchange environment. The parts of the document and how it should look are defined and included with the document. The International Consultative Committee on Telegraph and Telephone (CCITT) Recommendations of the T.410 series are technically identical to ISO 8613.

The logical structure of a document is a definition of the document's parts. A technical report is made up of parts such as chapters, sections, tables, page headers, and footers, etc. Many memos in an office have a common logical structure. Another example is a letter, which includes a date, a return address, a salutation, a body, and a closing. Each of these "parts" is a part of the logical structure of the document.

The layout structure of a document defines the areas of interest on a page which are to be filled with specific types of content or data. Many pages of a report can have the same layout, with areas for a header or footer, body text, footnotes, etc. For the example of a letter, there is a layout structure, as well as a logical structure, for the return address, the salutation, the body, and the closing; this includes the location on the page, the font, the margins, etc.

ODA also defines several content architectures. The content architectures are the descriptions of the actual information in a document (the information that is placed into the layout areas). Currently there are three content architectures defined: characters (text), raster graphics (CCITT Group 3 or Group 4 facsimile image encoding), and geometric graphics (Computer Graphics Metafile - CGM). Our example of a letter might include text content.

The Open Document Architecture (ODA) standard (ISO 8613) is not a CALS standard or specification. It is however referenced by the CALS raster specification MIL-R-28002B.

11.1.2 Encodings

There are two ways to encode the format and contents of an ODA conforming document. If the Abstract Syntax Notation One (ASN.1) is used, the resulting form is called ODIF. If the Standard Generalized Markup Language (SGML) is used, the resulting form is called ODL, and the result is an SGML application conforming to ISO 8879 (SGML). In this case, the SGML language is used as an "envelope" for the ODA document.

11.1.3 Production Support

An ODA document will be able to use typographic fonts defined by the Font Architecture standard currently being developed by the Accredited Standards Committee X3V1 (the US ODA TAG). Typographic fonts are essential for production of high quality annotated graphic pictures.

Color can be specified using the capabilities of the ODA color addendum recently approved by ANSI. This addendum provides for several different color spaces to be defined, and permits calibration data for the primaries and white point to accompany content data, so that color correction can be performed. However, since the document may be produced on a monochrome workstation, or printed on a black and white printer, the direct specification of color may be meaningless in the final output.

ODA can be translated into SPDL (Standard Page Description Language), which provides efficient mapping and output of ODA documents as well as other documents, to intelligent printers for execution.

11.2 TYPICAL APPLICATIONS

Examples of applications where ODA may be considered include:

- Small office documents (i.e., letters, memos, reports, contracts, invoices)
- Documents where the exact format must be carefully preserved during interchange
- Documents with a short life cycle (i.e., little update and maintenance is required)
- Documents that will not include portions that need to be reused to create other products
- Documents that are not required to support concurrent engineering (i.e., intelligent hooks into database information).

11.3 ARCHITECTURE

11.3.1 ODA Architecture

The ODA standard uses the term "architecture" to describe its capability to define the structure of documents made up of numerous "information objects." Often these documents are "compound" in that they contain different types of data (content architectures). This use of the term "architecture" is significant in comparison to the SGML standard, where there is no "architecture" in the standard. The SGML elements and their accompanying semantics are manipulated by a set of rules (a syntax for creating an architecture).

11.3.2 Architecture of the Standard

The ODA Standard does not define a data format which has to be used by an ODA implementation for the internal storage of documents. It also does not define functionality for preparing, deleting, filing, or retrieving documents. Currently there are seven parts to the ODA standard:

- Part 1: Introduction and General Principles - contains an overview of the complete standard, including descriptions of the other parts as well as their interdependencies. An annex shows the relationship of ODA to other standards, such as transfer standards and SGML.

- Part 2: Document structures - specifies the general structural concepts for ODA documents. This part defines the basic elements of a document architecture and the conceptual models necessary to understand the layout and imaging processes. It also defines the classes of allowed document architectures.

- Part 4: Document profile - describes the purpose and attributes of a document profile (i.e., a separate constituent of a document consisting of a set of attributes).

- Part 5: Office document interchange format (ODIF) - defines the precise rules for the data stream of an interchanged document. ODIF is based on the Abstract Syntax Notation One (ASN.1) defined in ISO 8824: 1987, Information Processing Systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1) and ISO 8825: 1987, Information Processing Systems - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1). This part also defines a clear text encoding called Open Document Language (ODL) which is based on ISO 8879: 1986, Information processing - Text and Office Systems - Standard Generalized Markup Language (SGML). ISO 9069: 1988, Information processing - SGML support facilities - SGML Document Interchange Format (SDIF) defines the interchange of ODA documents encoded using ODL.

- Part 6: Character content architectures - defines the encoding, the attributes, and the implementation of the layout and imaging processes for character content (text) in ODA documents. The attributes include: direction; spacing, and subscript/superscript; font, image inversion (the exchange of color between the graphic symbol and the character box); crossing out (deletions); blinking; underlining; style (italics); tabular attributes; indentation rules and interactions between presentation attributes and layout directives; and control functions, such as carriage return, tabs, line feed.

- Part 7: Raster graphics content architecture - defines the encoding, the attributes and the implementation of the layout and imaging processes for raster graphics data. At present this part does not support grayscale or multi-coloured pictures.

- Part 7: Tiling Addendum - contains the extensions to Part 7 needed to implementing tiling. Such attributes as tile size and tile type are specified.

- Part 7: Additional Bit Order Mapping Addendum - contains the extensions to Part 7 needed to encode CCITT Recommendation T.4/T.6 data in the down bit order sequence.

- Part 8: Geometric graphics content architecture - defines the encoding, the attributes, and the implementation of the layout and imaging processes for these pictures. The model for geometric graphics is ISO 8632 Computer Graphics Metafile for the Storage and Transfer of Picture Description Information (CGM). An ODA geometric picture is a picture encoded as Computer Graphics Metafile, in which the rules for determining the default values of CGM parameters and the coordinate system are different than those in ISO 8632. In addition, in ODA a CGM may contain only one picture.

- Part 9: (to-be-published) - will describe the audio content architecture.

- Part 10: Formal specifications - describes a Formal Description Technique (FDT) with precise and unambiguous syntax and semantics based on mathematical means/methodology. The aims of the Formal Specifications of the ODA Standard (FODA) are to provide: a basis for implementations of the Standard; a tool for the verification of conforming system; and, a reference point for future extensions and revisions to the Standard. This part currently only contains an FDT for document structures defined in Part 2, but the development of FTDs for the different content architectures contained in other parts of the Standard are underway.

11.4 INTERNATIONAL STANDARD PROFILES

International Standard Profiles (ISPs) are made of three parts: a Document Application Profile, Implementation Support Requirements (ISR) and Abstract Test Cases (ATC). Proposed Draft International Standardized Profiles (pDISP) need only contain Part 1, a DAP, to be considered by international standards bodies. ODA DAPs describe restricted subsets of the wide range of objects available under the ODA base International standard. DAPs are a way of standardizing the logical attributes of a class of applications, with the result being that standard features used by a sender are processable by a receiver. DAPs relieve implementors of having to support features not of use to a particular application. If a pDISP is considered to have the potential to become an International Profile, it becomes an Open Document Format (FOD).

Implementation Support Requirements (ISR) define the features of the DAP that must be supported by both a generator of a DAP compliant ODA-document and the receiver of the ODA-document. This implementation of the DAP may designate which options in the DAP are used and may not utilize all the features of the DAP. An ISR may exist for a region, country or group of countries. And therefore a DAP may have several ISRs. ISRs are used as a part of contracts to designate generator and receiver requirements.

Abstract Test Cases or Suites contain DAP implementation results that may be used to test generator or receiver compliance to the DAP.

11.5 STATUS AND PLANNED EXTENSIONS

ISO 8613 ODA was first published in 1989 and was intended originally for office documents such as page-oriented memos, reports, letters, invoices, etc. Since its publication several modifications and extensions have been made a part of the standard. It should be kept in mind that all changes to ISO 8613 are also reflected in the CCITT T.410 series of Recommendations and visa versa. The Consultative Committee on Telegraph and Telephone (CCITT) has recently changed its name to Telecommunication Standards Sector (TSS) and so all new or revised recommendations will bare this new name.

The CALS standard for interchange of raster data, MIL-R-28002 (Type I and Type II as defined in NISTIR 88-4017) was first issued in December 1988. It was revised by MIL-R-28002A in November of 1990 and again by MIL-R-28002B, 14 December 1992. The MIL-R-28002 (Raster) specification establishes requirements for a standard interchange file format and raster encoding scheme for raster data. MIL-R-28002 Type II data is a MIL-STD-1840 header wrapped around an Open Document Architecture (ODA)-style document conforming to the Document Application Profile (DAP) for raster contained in Part 7.

Although the addendum to Part 7 can be obtained from the CCITT or ISO editors, these documents have not been formally published by ISO. A new version of ISO 8613 (ODA) was originally expected in 1992, so it was determined that the addenda would simply be released as a part of this new version. The publication of this new version is now expected sometime in 1993, and these addenda have yet to be formally released. Telecommunication Standards Sector (TSS), formerly CCITT, has released "Recommendation T.417: Information Technology - Open Document Architecture (ODA) and Interchange Formats - Raster Graphics Content Architectures" which will become ISO 8613 (ODA) Part 7. TSS Recommendation T.417 does contain these required addenda.

The following addenda are extensions to ISO 8613:

- Addendum on document application profile proforma and notation

- Addendum on styles
- Addendum on alternate representations
- Addendum on security
- Addendum on tiled raster graphics
- Addendum on color and grayscale

Extensions currently being considered by ISO and TSS are:

- Limited hypermedia extensions
- The relationship of ODA to voice messaging
- Distributed applications
- Simultaneous access to a document
- The definition of office procedures
- Human interface to ODA documents
- Cooperative work on documents
- Incorporation of material by external reference
- Structures without a defined relationship to ODA
- Temporal relationships
- Embedded annotations and attached annotations
- Formulas and expressions
- Tables and spread sheets.

11.6 ADVANTAGES OF CURRENT SPECIFICATION

The ODA standard allows the storage of complex documents containing graphics and textual information and the production of compound documents using facsimile technology. ODA gives authors the option of full control over the appearance of their documents. In many situations this control is a business requirement. An architecture is predefined within the ODA standard, assuring its ability to be interchanged in an open environment without the need for negotiation between originator and receiver.

11.7 IMPLEMENTATION ISSUES

ODA puts focus on the layout of a document, not its logical structure. For this reason, an ODA-formatted document loses the identity of titles, footnotes, etc.; they are all character strings. The content, then, of the document has been lost to an intelligent automatic recipient. As the CALS environment moves towards integrated databases and shared data, ODA may not sufficiently handle future requirements.

In addition, the relative lack of intelligence and pointers to the information may inhibit the ability of ODA to develop adequate extensions for hypertext and hypermedia, where intelligent data is a requirement. This deficiency inhibits ODA's ability to support

automated processing such as an intelligent Electronic Review process in which comments can be associated with the information objects.

In ODA, the architecture and the semantics are defined within the standard. This restricts the capability of ODA to support new applications for new functional areas. This is a problem with including an ODA application in FIPS PUB 146-1 Government Open Systems Interconnection Profile (GOSIP), since it means that many applications must be included, one for each specific type of document.

The initial surge of CALS attention given to SGML has raised the issue of just how SGML and ODA can live together in the same system, or if they should. Most experts on the subject agree that ODA can be embedded into SGML, through ODL. EWOS/EG ODA/PT N 011 SGML/ODA Convergence is a report that discusses ODA and SGML interrelationships and is the result of the European Workshop for Open Systems (EWOS). The differences in targeted users (ODA is strictly for business applications; SGML is more general purpose) has been a common distinction, but is blurring as the ODA community attempts to gain ground by showing that documents other than "office" documents can be transferred with ODA. However, the strong tie between ODA objects and format presents a serious obstacle to ODA becoming a useful neutral data format appropriate for reuse.

There is concern within the computer graphics standards community about Part 8 of the ODA standard. Although this part defines an ODA CGM Application Profile, the CGM committees (ANSI X3H3 and ISO SC24) consider it of such poor quality that good implementations might not meet it and bad implementations could while providing no dependable communication of the picture. One example of a mistake in this CGM application profile is that it does not require the specification of a font list. This guarantees uncertainty of the final outcome from any transfer of the CGM.
Although ODA proponents want ODL encoding of ODA for CALS, other CALS users declare that CALS documents cannot be generated in ODA (the redundant storage of data inherent in the ODA combination of formatting and content does not neatly fit with some of the CALS goals). The presence of ODA in GOSIP as an exchange format suggests, to some users and implementers, that no other document exchange standard may be used by the Government and that ODA is the only format that can be exchanged through the GOSIP environment. Page 10 of FIPS PUB 146-1 (GOSIP) states the following " Although ODA is not an ISO protocol, it is included in GOSIP because it provides services required by Federal agencies, and information specified by the standard can be transported by the OSI FTAM and MHS Application layer protocols." Section 4.2.8.1 Office Document Architecture (ODA) describes the transfer of an ODA via services provided by MHS or FTAM. Neither reference indicates that ODA is the only exchange format that can be used for documents.

11.8 EXTENT AND NATURE OF USER AND VENDOR SUPPORT

The National Institute of Standards and Technology (NIST) has formed an OSI Implementors Workshop ODA Special Interest Group. This group is made up of large end-users and computer vendors, DoD and NIST participants and is responsible for identifying agreed upon standards for the OSI environment. The scope of the ODA SIG is to develop agreements concerning implementation and testing of ODA systems based on ISO 8613, its addendum and related international standards. It was responsible for developing:

- ISO/IEC International Standard Profile (ISP) 11181-1: 1992, Information technology - Standardized Profile FOD26 - Office Document Format: Enhanced document structure -Character, raster graphics and geometric graphics content architectures - Document Application Profile.

- ISO/IEC International Standard Profile (ISP) 11182-1: 1992, Information technology - Standardized Profile FOD36 - Office Document Format: Enhanced document structure - Character, raster graphics and geometric content architectures - Document Application Profile.

- Stable Implementation Agreements for Open Systems Interconnection Protocols: Part 22 - ODA Image DAP, March 1993; and

- Stable Implementation Agreements for Open Systems Interconnection Protocols: Part 23 - ODA Raster DAP, March 1993.

NIST is planning to issue the ODA Raster DAP as a FIPS PUB by the end of 1993. Once the FIPS is in place MIL-R-28002 will no longer contain the ODA Raster DAP as an appendix, and in its place will reference the appropriate FIPS. NIST has also added ODA into their Application Portability Profile.

The ODA Raster DAP published in the September 1992 OIW Stable Implementation Agreements and Appendix A to MIL-R-28002B, was presented to the Profile Alignment Group for ODA (PAGODA) for consideration as an International Profile. PAGODA delegations agreed to propose to the respective workshops that a specification be developed with the intent of achieving a proposed Draft International Standardized Profile (pDISP). In International circles a Profile is called an Open Document Format (FOD). The ODA Raster DAP was widely circulated among the respective workshops and comments were forwarded to the OIW ODA SIG. PAGODA delegations represent the OIW, Asia-Oceania Workshop (AOW), European Workshop for Open Systems (EWOS), and CCITT Study Group VIII. PAGODA has requested that FOD112 allow the 512 tile size default and any other tile size for greater flexibility. This tile size change was made to FOD112, but not to the ODA Raster DAP. Therefore the ODA Raster DAP is now a subset of pDISP FOD112. This profile will be reviewed using the International Profile Progressive Schedule with a June 1994 projected date for becoming an International Profile.

The Electronic Imaging/Compression Committee (C.13.7) of the Association for Information and Image Management (AIIM) has developed a standard, ANSI/AIIM MS53 1993, "Standard Recommended Practice - File Format for Storage and Exchange of Images - Bi-Level Image File Format: Part 1", that specifies a file format for the exchange of bi-level, electronic images. MS53 is considered a subset of the ODA Raster DAP, but it does not allow for the tiling of raster images. This standard has been developed to encourage the use of ODA by the United States image technology community and to provide a much needed standard bi-level image file format. It is seen as an introductory tool for users and implementors of ODA, ASN.1 and ODA Raster DAP applications requiring MIL-R-28002 Type II untiled data. MS53 is AIIM's attempt at a "cookbook" approach to the exchange of bi-level electronic images using ODA with ASN.1 encoding.

Several of the document systems that produce or accept either an ODA ODIF or an ODA ODL data stream are:

- InterLinear
- Digital Equipment Corporation (DEC): Compound Document Architecture with ODA-like features which supports ODIF.
- International Business Machines (IBM): ODA-based product.
- Nixdorf of Canada: ODA-based product that creates an ODIF output.
- Several companies in Europe.
- The European Economic Community ESPRIT project.

11.9 STRUCTURE OF DEVELOPMENT ORGANIZATION

The ODA standard was developed within ANSI Accredited Standards Committee X3V1 Text and Office Systems. Its international counterpart (ISO 8613) was developed by ISO SC18 Working Group 3.

11.10 REFERENCE AND IMPLEMENTATION DOCUMENTS AVAILABLE

1. Appelt, Wolfgang. Document Architecture in Open Systems, The ODA Standard, Springer-Verlag, New York, 1991.

2. ANSI/AIIM MS53-1993: Standard Recommended Practice - File Format for Storage and Exchange of Images - Bi-Level Image File Format: Part 1.

3. CCITT Recommendation T.6: 1988, Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus.

4. FIPS PUB 150: 4 November 1988, Telecommunications: Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus.

5. ISO 8613-1: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 1: Introduction and General Principles.

6. ISO 8613-2: 1989, Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 2: Document Structure.

7. ISO 8613-5: 1989, Information processing - text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 5: Open Document Interchange Format.

8. ISO 8613-7: (to be published in 1993), Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 7: Amendment - Tiled Raster Graphics Addendum to ISO 8613, Part 7.

9. ISO 8613-7: (to be published), Information processing - Text and Office Systems; Open Document Architecture (ODA) and Interchange Format - Part 7: Amendment - Additional Bit Order Mapping Addendum to ISO 8613, Part 7.

10. ISO 8824: 1987, Information Processing Systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1).

11. ISO 8825: 1987, Information Processing Systems - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).

12. ISO 8879: 1986, Information processing - Text and Office Systems - Standard Generalized Markup Language (SGML).

13. ISO 9069: 1988, Information processing - SGML support facilities - SGML Document Interchange Format (SDIF).

14. MIL-M-28001: 1990, MILITARY SPECIFICATION, MARKUP REQUIREMENTS AND GENERIC STYLE SPECIFICATIONS FOR ELECTRONIC PRINTED OUTPUT AND EXCHANGE OF TEXT.

15. "User Requirements for the New Project on 'ODA Document Processing'," X3V1.1/90-44.

16. "Standards for the Interchange of Large Format Tiled Raster Documents," NISTIR 88-4017.

17. CALS Report, Vol 2, No. 8, August 1989.

18. "Overview of X3V1 (Text and Office Publishing Systems) Standards," B. Shepherd, X3H3/89-167.

19. "ODA: What Is It? What Is It Good For?," The Seybold Report on Publishing Systems, Volume 19, Number 7.

20. Kemmerer, S.J., October 1992, Computer-aided Acquisition and Logistic Support (CALS) Testing: Programs, Status, and Strategy, NISTIR 4940, Information Systems Engineering Division, Computer Systems Laboratory, NIST.

21. Spielman, F.E. May 1992, Raster Graphics Validation, NISTIR 4848, U.S. Department of Commerce, Technology Administration, NIST.

22. Spielman, F.E., and Sharpe L.H. 1993, Raster Graphics: A Tutorial and Implementation Guide, NISTIR 5108, Computer Systems Laboratory, NIST.

23. TSS (formerly CCITT) Recommendation T.417: 1993, Information Technology - Open Document Architecture (ODA) and Interchange Formats - Raster Graphics Content Architectures.

SECTION 12 - ISO 10303 Standards: STEP/PDES

12.1 Purpose:

STEP (STandard for the Exchange of Product model data) is the unofficial name for the ISO 10303 standards which are being developed by the International Organization for Standardization (ISO). STEP is formally called the "Industrial Automation Systems and Integration - Product Data Representation and Exchange Standard". In the United States, STEP is known as PDES which stands for "Product Data Exchange using STEP". PDES is the U. S. organizational activity that supports the development and implementation of STEP.

STEP is an international standard which is being designed to give a complete computer-interpretable representation of product data in a neutral format throughout the complete product life-cycle (design, engineering analysis, manufacture, support and maintenance, and disposal). This representation makes it suitable not only for file exchange but also as a basis for implementation, sharing, and archiving product databases.

With the proliferation of computer-aided design, manufacturing, and engineering systems (CAD/CAM/CAE), all product data can be captured in digital form. The ability to transfer such product data in computer-readable format from one system to another is essential. Once the STEP standard is defined and implemented on various systems, then such systems can accept, use, and exchange product data so that developers, suppliers, vendors, and manufacturers will be able to receive and supply information about product parts and materials digitally. This will mean shorter development times, higher quality products, lower costs. It will also ensure flexibility and responsiveness to the needs of customers, manufacturers, suppliers, and users.

The STEP standards are fundamental to the Computer-aided Acquisition and Logistics Support (CALS) effort. CALS encompasses an architecture for Contractor Integrated Technical Information Services (CITIS) which requires an Integrated Weapon System DataBase (IWSDB). The STEP shared data environment will provide the kernel of the IWSDB and will support information access for prime contractors, sub-contractors, and the DoD.

The scope of STEP standards development is immense with respect to the variety of products addressed. It is important to the United States' competitive posture in the world marketplace that the STEP working experience base be strengthened through increased American participation so that the STEP standards will favorably encompass American industry practices and requirements.

12.2 Typical Application:

A typical application of product data in the form of a STEP file is shown in the following figure:

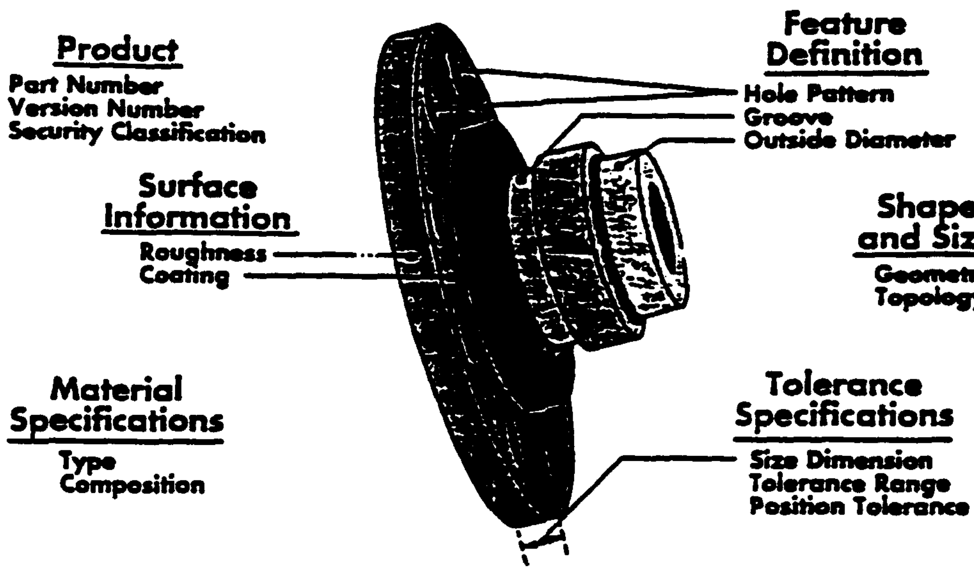

Figure 3 - Example of a STEP data file

12.3 Architecture of the Standard:

12.3.1 STEP Parts:

STEP is organized as a series of Parts which are divided into six logical groups. Each of these groups is called a Class. Each Class has a unique function in STEP. Within each Class, documentation for each Part is being developed. STEP is being published as a set of inter-related standards, each of which falls into one of the six Classes in the following figure.

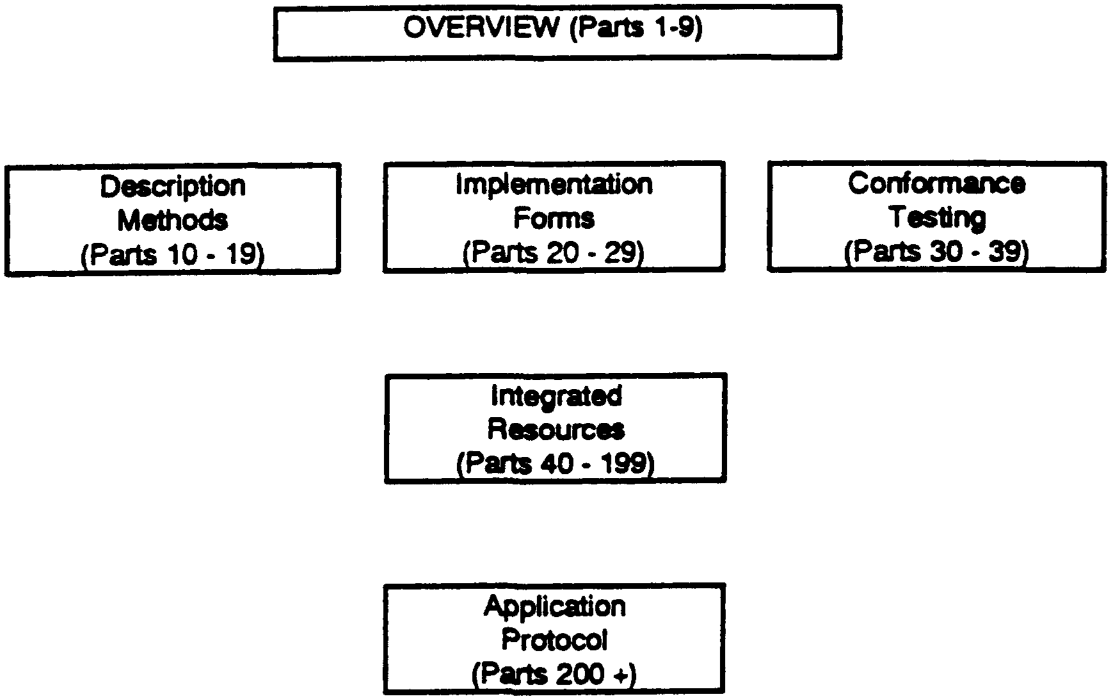

Figure 4 - STEP Parts

12.3.1.1 Overview (Parts 1 - 9):

This Class provides an overview of all the STEP standards. Currently, only one Part, Part 1 - Overview and Fundamental Principles, has been developed. Other Parts in this Class may be developed in the future.

12.3.1.2 Description Methods (Parts 10 - 19):

This Class specifies the methods used to describe the information models found in both the Integrated Resources Class and Application Protocols (APs) Class. Only one part, Part 11 - EXPRESS language, has been developed.

The EXPRESS language provides the mechanism for the description of product data for both integrated resources and APs within STEP. This description is independent of any implementation method and will support all such methods defined in STEP consistently.

12.3.1.3 Implementation Forms (Parts 20 - 29):

This Class specifies the methods for exchanging and sharing data captured from information models. Only Part 21 which defines the passive file exchange implementation method has been developed.

12.3.1.4 Conformance Testing (Parts 30 - 39):

This Class specifies the methods that determine whether a STEP implementation conforms to the standard. Only Part 31 dealing with Conformance Testing Methodology has been developed.

12.3.1.5 Integrated Resources (Parts 40 - 199):

This Class provides the specification of integrated conceptual information models for all of the STEP effort. Within this Class, there are two types of STEP Parts:

a. Generic Resources (Parts 40 - 99): These are Parts comprised of concepts and constructs that may be used by many applications, including the higher level Application Resources and APs.

b. Application Resources (Parts 100 - 199): These are Parts containing conceptual constructs for specific application areas. These Parts may be used by many APs.

12.3.1.6 Application Protocols (Parts 200 +):

These Parts, the Application Protocols (APs), provide the mechanism both for specifying implementation requirements and for ensuring reliable information communication within the context of a given application. An AP is a complete specification of the context and scope for the use of product data in a particular domain using standardized integrated resources and other application specific entities. The AP also describes the conformance requirements and test purposes from which its abstract test suite is derived. Parts in this Class are numbered 200 and above. (See Section 12.4)

12.3.2 The Component of STEP AP:

The use of the STEP standards to support a particular application domain is based on the concept of the AP. The AP provides a complete explicit statement of the product data representation required to meet the specific needs of a particular application. The AP defines the scope and context of the application in terms of four major components:

12.3.2.1 Scope and Application Activity Model:

The scope statement defines the domain of the AP and summarizes the functionality and data that are accommodated by the AP. The scope statement is based on an

Application Activity Model (AAM) developed by the Integrated Computer-aided Manufacturing Definition Method (IDEF0). The AAM is used to clarify the application activities, processes, and data flows involved in the application.

12.3.2.2 Information Requirements and Application Reference Model:

The Application Reference Model (ARM), formally describes the information content, structure, and constraints with regard to the specific application domain. The ARM provides the basis for specifying and verifying the information requirements of the AP. The ARM is developed in one of the following modeling languages: EXPRESS, the Integrated Computer-aided Manufacturing Definition Method (IDEF1X), or Nijssen's Information Analysis Methodology (NIAM).

12.3.2.3 Application Interpreted Model:

An Application Interpreted Model (AIM) specifies the constructs selected from the integrated resources and interprets them to meet the needs of the application. The AIM is defined using the EXPRESS language.

12.3.2.4 Conformance Requirements and Test Purposes:

The AP also includes a set of conformance requirements and test purposes from which an abstract test suite may be developed and used for conformance testing.

12.4 Status and Planned Extensions:

12.4.1 STEP Initial Release:

Twelve STEP Parts (Ref. 1) were registered for Draft International Standard (DIS) status in May 1993. This initial release of STEP will provide capabilities for the exchange of two-dimensional drafting product data and the configuration controlled exchange of three-dimensional product definition data with emphasis on mechanical parts and assemblies. The initial STEP release establishes a foundation for subsequent releases of STEP. This initial release of STEP includes the following Parts:

Part 1 - Overview and Fundamental Principles
Part 11 - EXPRESS Language Reference Manual
Part 21 - Clear Text Encoding of the Exchange Structure
Part 31 - Conformance Testing Methodology
Part 41 - Fundamentals Product Description and Support
Part 42 - Geometric and Topological Representation
Part 43 - Representation Structures
Part 44 - Product Structure Configuration
Part 46 - Visual Presentation
Part 101 - Drafting
Part 201 - Explicit Drafting
Part 203 - Configuration Controlled Design

12.4.2 STEP Subsequent Releases:

Subsequent STEP releases will provide added functionality and extend the capabilities of the Parts in the Initial Release. The schedule for these STEP subsequent releases has not been determined. The following Parts are currently being developed.

Part 22 - STEP Data Access Interface (SDAI)
Part 32 - Test Laboratory Requirements
Part 33 - Structure and Use of Abstract Test Suites
Part 34 - Abstract Test Methods
Part 45 - Materials Products
Part 47 - Shape Tolerances
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12.5 Advantages of Current Specification:

STEP is an extremely broad specification, including virtually every data item required to develop, analyze, manufacture, document, and support products ranging from mechanical products to electronic products to large structures such as ships and buildings, etc.

STEP is a conceptual specification for communicating product information at all stages in a product's life cycle, covering all aspects of product description and manufacturing specifications. The fundamental components of STEP are product information models and specifications to exchange information corresponding to these product models.

STEP will provide tools to reduce time to market, reduce costs, improve quality, and

continuously improve processes. STEP will allow all information from finance, marketing, engineering, manufacturing, support, etc. to work together and share data. STEP data is open: it is independent of the applications or systems that create it, and is accessible to and usable by any other applications that need to use it. STEP will provide the ability to turn data into meaningful information to support decision making. STEP will provide a foundation for the next generation of open systems.

12.6 Implementation Issues:

The Initial Release of DIS STEP is available for implementation. The emphasis on software applications is currently focused on creating APs which are focused on high value industrial processes.

12.6.1 Implementation of APs:

APs are the implementable parts of STEP. Many APs are in the planning or development stages. Guidelines (Ref. 2) for the development of APs are documented and are available through the U. S. Product Data Association (see Section 12.8.2).

When an AP is proposed for development, approval is required from the IGES/PDES Organization (IPO). The AP proposal requires a precise definition of scope and a detailed plan for development. The development of the AP proceeds in accordance with the STEP guidelines. The draft AP is reviewed and balloted through the international standards process.

12.6.2 Software Tools:

There is a growing recognition of the need for software tools to facilitate the STEP standards development, application software implementation, and testing process.

Software tools can be catalogued in four major groupings.

Standards development tools: Parsers, compilers, editors, schema generators, etc.

STEP data exchange tools: Software to generate and interpret STEP physical files and databases, etc.

Data management tools: STEP data access interfaces and database management software, etc.

End User Tools: Translators, etc.

12.6.3 Implementation Levels:

STEP provides a wide variety of levels for system implementation. Implementation levels are particular ways of storing, exchanging or accessing information which are distinguished by the degree of data sharing. Those levels may include the following:

- Exchange File - Product data is exchanged between computer systems or applications using STEP exchange files which are defined in STEP Part 21. The structure of the exchange file is derived from the conceptual data model's EXPRESS definition. It is expected that the early use of STEP will involve using exchange files to move data between systems.

- Database - Product data is stored and accessed in databases based on various database architectures (such as relational or object-oriented). This database level will allow application developers to create, manipulate, and share STEP data, based on standard data models and system interfaces. Applications use a standard query language such as SQL or standard interfaces such as the STEP Data Access Interface (SDAI) defined in Part 22.

- Data Access - Product data can be accessed independently of the storage method used.

12.6.4 Testing:

The STEP testing activities are categorized as follows:

- Standards testing: It addresses the quality of the evolving STEP specification itself. These validation efforts provide assurance that the methods employed by STEP will indeed work, and that the standard provides a means to meet the functionality that it claims to support.

- Component testing: This is the preliminary testing conducted by the STEP software implementor to verify that the application software addresses both the basic requirements imposed for compliance with the standard and the users' functionality requirements.

- Conformance testing: It evaluates a software product with respect to the specifications provided in a Part of a STEP standard and tests for the presence of these characteristics required by the standard itself. STEP includes the specifications for Conformance testing as a requirement built into many Parts of the standard.

- Acceptance testing: It is concerned with the user's specific requirements. It tests a software product against a set of requirements defined by the users of that software product. This type of testing may include performance, user interfaces and inter-operability with other systems.

Current efforts are primarily focused on developing methods for Conformance and Standards testing. Component and Acceptance testing activities have just gotten underway within the vendor and user communities.

12.6.5 Training and Education:

The STEP standard is technically complex and requires different types of skills for the from development of the standard, as well as, its implementation in a production environment. Training has been focused on the highly technical needs of the developers. As industry proceeds from the standards development stage to testing and implementation, additional types of training are needed for the new users, new developers, and even experienced staff. More formal, structured training programs will be required to effectively transfer the needed information to users.

12.6.6 IGES to PDES Migration:

The Initial Graphics Exchange Specification (IGES) is an ANSI standard which provides a neutral data format for exchanging mechanical product data. IGES was not originally intended to capture extensive product information for the entire product life-cycle. Strategies for migrating from IGES to PDES are being proposed by and discussed within U. S. standards development bodies.

12.7 Extent and Maturity of User and Vendor Support:

Tools for modeling and developing specialized applications in STEP have been available, primarily in standards development and research activities, since the mid-1980's. As the technology has gained momentum, commercial suppliers' efforts are being focused on providing more tools for software developers and implementors.

Recently, several STEP toolkits have been introduced commercially. These tools provide needed resources for the developers and implementors and they should accelerate development of applications. There is a growing recognition of the need for software tools to facilitate development and testing processes. This should lead to additional tool development for these activities.

12.8 Structure of Development Organization:

12.8.1 ISO TC184/SC4:

ISO (Ref. 3) was established in 1946 with the objective of promoting the worldwide development of standards to facilitate the international exchange of goods and services and also develop cooperation in the sphere of intellectual, scientific, technological, and economic activity.

In 1984, ISO initiated Technical Committee TC184 (Industrial Automation Systems) and formed Subcommittee SC4 (Industrial Data and Global Manufacturing Programming Language) to work on the representation and exchange of digital product data. The work of TC184/SC4 includes development of international standards dealing with the use of digital product and manufacturing management data. The TC184/SC4's technical work is organized into eight Working Groups (WGs) and three Advisory Groups (AGs).

WG2 - Standards Parts: The scope of WG2 is to design a set of standards that specify how a library supplier shall describe his library in such a way that this library might be integrated automatically into any User Part Library.

WG3 - Product Modeling: The scope of WG3 is to develop all Parts (resources models and application protocols) of STEP for qualification and integration.

WG4 - Qualification and Integration: The scope of WG4 is to qualify and integrate of all Parts of STEP.

WG5 - Development Methods: The scope of WG5 is to provide the methods necessary for the development of STEP.

WG6 - Conformance Testing: The scope of WG6 is to provide standards for the conformance testing of all Parts of STEP.

WG7 - Implementation Specifications: The scope of WG7 is to develop the physical file standards and the STEP Data Access Interface Specification, and also to serve as a resources for STEP implementation.

WG8 - Industrial Manufacturing Management Data: The scope of WG8 is to develop the methods and the standardized data to express information exchanged inside industrial manufacturing plants.

Strategic Planning Advisory Group (SPAG): The scope of SPAG is the coordination of SC4 activities.

Project Management Advisory Group (PMAG): The scope of PMAG is the project management of all STEP development activities within SC4.

Editing Committee (EC): The scope of EC is to assist in the preparation of texts, consistent with the ISO Directives and also to review them for technical coherence with other texts.

12.8.2 US Product Data Association:

US PRO is the parent organization that provides management and strategic direction for organizations engaged in research, development, implementation, and testing of standards and specifications for the exchange and sharing of product data information. US PRO was established by industry to work on its behalf. It was created to bring together the major volunteer user communities to develop standards, and also to provide a forum for the exchange of experiences. Program areas include the IGES/PDES Organization (IPO), the National IGES User Group (NIUG) and the US Technical Advisory Group to ISO.

IPO was established in 1980 and consists of over 500 voluntary industry, government,

and academic personnel who meet quarterly to work on technical aspects of product data exchange. IPO is composed of two groups, the Steering Committee and the General Assembly. Each group has a distinct role in the development of IGES and PDES (or STEP).

The IPO Steering Committee is the management committee for the organization. It sets policies, goals, milestones, and deliverables and approves procedures and personnel assignments. The General Assembly is composed of 27 technical committees which are involved in the technical development of both IGES and STEP. The IPO is administrated by the National Computer Graphics Association (NCGA) while National Institute of Standards and Technology (NIST) is chartered with hosting the chair of IPO.

12.8.3 National Initiative for Product Data Exchange (NIPDE):

NIPDE (Ref. 4) is an industry-led, government-facilitated organization established to accelerate product data exchange (PDE) development and implementation. NIPDE works to expand the PDE community, unite those already in it, and leverage everyone's efforts. Its participants include companies, corporate consortia, standards organizations, and government agencies who agree to active involvement in NIPDE programs.

NIPDE has developed a PDE Road MAP which currently includes aerospace, automative, electrical-electronics, infrastructure, shipbuilding and construction industries. This Road Map will help focus efforts, identify voids, and provide a basis to minimize redundant activities. It should be useful to both standards and software developers, as well as vendors, testers, educators, users, and procurement managers.

12.8.4 National PDES Testbed:

The National PDES Testbed, established at NIST in 1988 as a part of the U.S. Department of Defense (DoD) CALS program, is a publicly accessible facility that supports the development of product sharing technologies for DoD, other government agencies, and industry. The PDES Testbed facility comprises laboratories, computer hardware, software systems, and testing tools.

12.8.5 PDES, Inc.:

PDES, Inc. was formed in 1988. It is the major funded STEP development activity in the US. Twenty national and international companies are presently participating in PDES, Inc. The goal of PDES, Inc. is to accelerate the development and implementation of PDES. The South Carolina Research Authority (SCRA) was awarded the contract to provide management support. PDES, Inc. members share resources and costs to develop, test, and implement STEP.

12.8.6 Navy/Industry Digital Data Exchange Standards Committee:

The Navy/Industry Digital Data Exchange Standards Committee (NIDDESC) is a cost-sharing venture between the Naval Sea Systems Command (NAVSEA) and the shipbuilding industry. NIDDESC has subcommittees devoted to specific areas of digital data transfer. The basic objectives are to develop an industry-wide consensus on product data models for ship structures and distribution systems, and also for the digital exchange of product model data. Efforts include contributions to IGES, STEP, and the analysis of ship production data flows.

12.9 Reference and Implementation Documentation:

1. DIS 10303 (STEP) Standards, Initial Release, May 1993

2. Mark Palmer and Mitch Gilbert, "Guidelines for the Development and Approval of STEP Application Protocols", WG5/P5 Working Draft, 7 January 1993

3. ISO TC184/SC4 "Reference Manual" (Draft), October 1992

4. "Product Baseline Activities", National Initiative for Product Data Exchange, Release 1, October 1992.

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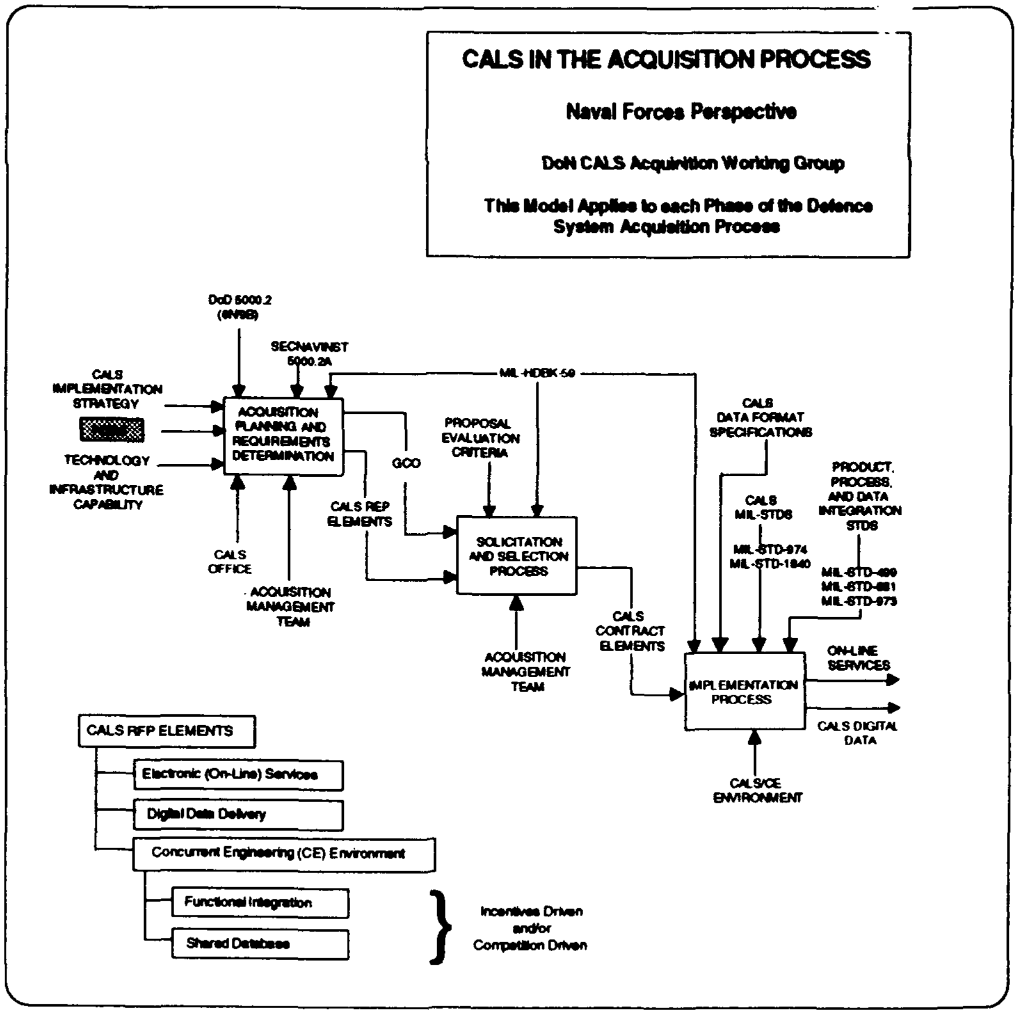
SECTION 10

Program CALS Self Assessment Checklist



PROGRAM CALS SELF ASSESSMENT CHECKLIST

PROGRAM DOCUMENTATION

Milestone I - Concept Demonstration Approval.

1. Do acquisition/program requirements planning documents (AP, CMP, NTP, and TEMP) establish clear objectives for CALS?

Reference: DoDI 5000.2 (6-N), SECNAVINST 5000.2, and OPNAVINST 4120.5
Guidance: CALS objectives should be identified as a set of methodologies for risk reduction, acquisition cycle time reduction and reduction in the cost of data acquisition and ownership. NAVSUP Publication 594 offers general guidance for the acquisition and management of technical data and also discusses CALS objectives in general terms. OPNAVINST 4120.5 provides specific CALS goals and objectives for the Navy..

2. Do the AP and supporting program management documentation such as the TDMP reflect planning to develop, acquire, maintain and use technical information in digital form?

Reference: DoDI 5000.2 (6-N and 9-B),

3. Has a Government Concept of Operations (GCO) been developed. Is the GCO identified as Government Furnished Information (GFI) in the DEM/VAL RFP.

Reference: SECNAVINST 5230.X
Guidance: MIL-HDBK-59 and Acquisition Guidance for Implementation of CALS

4. Has the program obtained or planned to obtain specific proposals, including costs and schedule, for:

a. Integration of contractor technical information systems and processes for engineering, manufacturing and logistics support.

b. Authorized government access to contractor data bases.

c. Delivery of technical information in digital form using computer-aided acquisition and logistics support standards contained in MIL-STD-1840.

Reference: DoDI 5000.2 (6-N)

5. Has a CALS Implementation Plan (CALSIP) been identified as a proposal requirement of the DEM/VAL RFP and/or as a contract deliverable (either as a CALSIP or as a section within another management plan)?

Reference: SECNAVINST 5230.X
Guidance: MIL-HDBK-59 and Acquisition Guidance for Implementation of CALS

6. Does CALS implementation planning identify how the program will interface with the existing and/or evolving Department of the Navy CALS infrastructure?

Reference: DoDI 5000.2 (9-B), OPNAVINST 4120.5

Guidance: The program should have evaluated whether receiving systems are in place for the management and use of program digital technical information (TI). Where the planned CALS receiving systems are not in place at the time of technical information delivery, the program should have identified interim solutions and required resources to manage and use digital TI.

7. Does the DEM/VAL RFP Statement Of Work (SOW) and Contract Data Requirements List (CDRLs) require the delivery of technical information and data products in digital form using either on-line access to the contractor data base or MIL-STD-1840.

Reference: DoDI 5000.2 (6-N and 9-B)
Guidance: MIL-HDBK-59

8. Have source selection criteria/evaluation factors been established that give increased consideration to contractor proposals that demonstrate the capability to develop integrated, shared data base environments consisting of analysis tools, consistent integrated data bases, and engineering processes designed to utilize digital information.

Reference: DoDI 5000.2 (6-N)
Guidance: What other initiatives has the program undertaken to improve acquisition and support processes through CALS implementation? Examples would include acquisition of LSAR in digital form; clear plans to update and maintain the LSAR for use as the source database for logistics product development/update; development of links with maintenance information feedback systems to automate the update of operation and maintenance related data in the appropriate database; and use of logistics R&D to identify additional CALS related applications. MIL-HDBK-59 provides guidance.

Milestone II - Development Approval

1. Do acquisition/program requirements documents (AP, CMP, NTP and TEMP) include updated CALS objectives.

Reference: DoDI 5000.2 (6-N) and SECNAVINST 5000.2

2. Do the AP and supporting program management documentation such as the TDMP reflect planning to develop, acquire, maintain and use technical information in digital form?

Reference: DoDI 5000.2 (6-N and 9-B)

3. Has the program obtained or planned to obtain specific proposals, including costs and schedule, for:

a. Integration of contractor technical information systems and processes for engineering, manufacturing and logistics support

b. Authorized government access to contractor data bases

c. Delivery of technical information in digital form using computer-aided acquisition and logistics support standards contained in MIL-STD-1840.

Reference: DoDI 5000.2 (6-N)

4. Has the Government Concept of Operations (GCO) been updated to reflect current requirements. Is the GCO identified as Government Furnished Information (GFI) in the Engineering & Manufacturing Development (EMD) RFP.

Reference: SECNAVINST 5230.X
Guidance: MIL-HDBK-59 and Acquisition Guidance for Implementation of CALS

5. Has a CALSIP been identified as a proposal requirement of the EMD RFP and/or as a contract deliverable (either as a CALSIP or as a section within another management plan).

Reference: SECNAVINST 5230.X
Guidance: MIL-HDBK-59 and Acquisition Guidance for implementation of CALS

6. Does the approved CALSIP identify how the program will interface with the existing and/or evolving Department of the Navy CALS infrastructure?

Reference: DoDI 5000.2 (9-B), OPNAVINST 4120.5
Guidance: The program should have evaluated whether receiving systems are in place for the management and use of program digital technical information (TI). Where the planned CALS receiving systems are not in place at the time of technical information delivery, the program should have identified interim solutions and required resources to manage and use digital TI.

7. Does the EMD RFP Statement Of Work (SOW) and Contract Data Requirements List (CDRLs) require the delivery of technical information and data products in digital form using either on-line access to the contractor data base or MIL-STD-1840.

Reference: DoDI 5000.2 (6-N and 9-B)
Guidance: MIL-HDBK-59

8. Have source selection criteria/evaluation factors been established that give increased consideration to contractor proposals that demonstrate the capability to develop integrated, shared data base environments consisting of analysis tools, consistent integrated data bases, and engineering processes designed to utilize digital information.

Reference: DoDI 5000.2 (6-N), (10-B, C), SECNAVINST 5000.2, OPNAVINST 4120.5
Guidance: What other initiatives has the program undertaken to improve acquisition and support processes through CALS implementation? Examples would include acquisition of LSAR in digital form; clear plans to update and maintain the LSAR for use as the source database for logistics product development/update; development of links with maintenance information feedback systems to automate the update of operation and maintenance related data in the appropriate database; and use of logistics R&D to identify additional CALS related applications. MIL-HDBK-59 provides guidance.

Milestone III - Production Approval.

1. Do acquisition/program requirements documents (AP, CMP, NTP and TEMP) include updated CALS objectives.

Reference: DoDI 5000.2 (6-N) and SECNAVINST 5000.2

2. Do the AP and supporting program management documentation such as the TDMP reflect planning to develop, acquire, maintain and use technical information in digital form?

Reference: DoDI 5000.2 (6-N and 9-B)

3. Has the program obtained or planned to obtain specific proposals, including costs and schedule, to evaluate the cost effectiveness (over the anticipated life cycle) of:

a. Integration of contractor technical information systems and processes for engineering, manufacturing and logistics support

b. Authorized government access to contractor data bases

c. Delivery of technical information in digital form using computer-aided acquisition and logistics support standards contained in MIL-STD-1840.

Reference: DoDI 5000.2 (6-N)

4. Has the Government Concept of Operations (GCO) been updated to reflect current requirements. Is the GCO identified as Government Furnished Information (GFI) in the Production RFP.

Reference: SECNAVINST 5230.X
Guidance: MIL-HDBK-59 and Acquisition Guidance for Implementation of CALS

5. Has a CALSIP been identified as a proposal requirement of the Production RFP and/or as a contract deliverable (either as a CALSIP or as a section within another management plan).

Reference: SECNAVINST 5230.X
Guidance: MIL-HDBK-59 and Acquisition Guidance for implementation of CALS

6. Does the approved CALSIP identify how the program will interface with the existing and/or evolving Department of the Navy CALS infrastructure?

Reference: DoDI 5000.2 (9-B)
Guidance: The program should have evaluated whether receiving systems are in place for the management and use of program digital technical information (TI). Where the planned CALS receiving systems are not in place at the time of technical information delivery, the program should have identified interim solutions and required resources to manage and use digital TI.

7. Does the Production RFP Statement Of Work (SOW) and Contract Data Requirements List (CDRLs) require the delivery of technical information and data products in digital form using either on-line access to the contractor data base or MIL-STD-1840.

Reference: DoDI 5000.2 (6-N and 9-B)
Guidance: MIL-HDBK-59

8. Has a CITIS Transition Plan, as a part of the CALSIP, been developed to identify how the Contractor will transition the program's digital TI to the Government.

Reference: SECNAVINST 5230.X
Guidance: The program may identify the CALSIP as a proposal requirement of the Production RFP and/or as a contract deliverable (either as a CALSIP or as a section within another management plan). MIL-STD-CITIS provides guidance.

9. Have source selection criteria/evaluation factors been established that give increased consideration to contractor proposals that demonstrate the capability to develop integrated, shared database environments consisting of analysis tools, consistent integrated data bases, and engineering processes designed to utilize digital information?

Reference: DoDI 5000.2 (6-N)
Guidance: What other initiatives has the program undertaken to improve acquisition and support processes through CALS implementation? Examples would include acquisition of LSAR in digital form; clear plans to update and maintain the LSAR for use as the source database for logistics product development/update; development of links with maintenance information feedback systems to automate the update of operation and maintenance related data in the appropriate database; and use of logistics R&D to identify additional CALS related applications. MIL-HDBK-59 provides guidance.

Milestone IV - Major Modification Approval

1. Does the CALS infrastructure support the management and use of acquired digital technical information (TI). If the infrastructure is not in place, is an interim solution identified and the required resources available to manage and use the acquired digital data.

Reference:
Guidance:

2. Has the Contractor transitioned the program's digital TI to the Government in accordance with the *CITIS* Transition Plan?

Reference: SECNAVINST 5230.X
Guidance: MIL-STD-CITIS

TECHNICAL MANUALS

Milestone I.

1. Does the DEM/VAL RFP Statement of Work (SOW) and Contract Data Requirements List (CDRL) require that TMs be developed digitally (using CALS specifications MIL-D-28000, MIL-M-28001, MIL-R-28002, MIL-D-28003 & MIL-M-29532) and delivered digitally (using MIL-STD-1840).

Reference: DoDI 5000.2 (9-B)
Guidance: MIL-HDBK-59

Milestone II.

1. Does the EMD RFP Statement of Work (SOW) and Contract Data Requirements List (CDRL) require that TMs be developed digitally (using CALS specifications MIL-D-28000, MIL-M-28001, MIL-R-28002, MIL-D-28003 & MIL-M-29532) and delivered digitally (using MIL-STD-1840).

Reference: DoDI 5000.2 (9-B)
Guidance: MIL-HDBK-59

Milestone III.

1. Does the Production RFP Statement of Work (SOW) and Contract Data Requirements List (CDRL) require that TMs be developed digitally (using CALS specifications MIL-D-28000, MIL-M-28001, MIL-R-28002, MIL-D-28003 & MIL-M-29532) and delivered digitally (using MIL-STD-1840).

Reference: DoDI 5000.2 (9-B)
Guidance: MIL-HDBK-59

Milestone IV

TECHNICAL DATA (DRAWINGS)

Milestone I.

1. Does the DEM/VAL RFP Statement of Work (SOW) and Contract Data Requirements List (CDRL) require that Technical Data (Drawings) be developed digitally (using CALS specifications MIL-D-28000, MIL-M-28001, MIL-R-28002, MIL-D-28003 & MIL-M-29532) and delivered digitally (using MIL-STD-1840).

Reference: DoDI 5000.2 (9-B)
Guidance: MIL-HDBK-59

2. Does the DEM/VAL RFP SOW and Technical Manual Contract Requirement require the development of ILS products, such as technical manuals and training materials, using the engineering drawing database as the primary source for illustrations?

Reference: SECNAVINST 5230.X

Milestone II.

1. Does the EMD RFP Statement of Work (SOW) and Contract Data Requirements List (CDRL) require that Technical Data (Drawings) be developed digitally (using CALS specifications MIL-D-28000, MIL-M-28001, MIL-R-28002, MIL-D-28003 & MIL-M-29532) and delivered digitally (using MIL-STD-1840).

Reference: DoDI 5000.2 (9-B)
Guidance: MIL-HDBK-59

2. Does the EMD RFP SOW and Technical Manual Contract Requirement require the development of ILS products, such as technical manuals and training materials, using the engineering drawing database as the primary source for illustrations?

Reference: SECNAVINST 5230.X

Milestone III.

1. Does the Production RFP Statement of Work (SOW) and Contract Data Requirements List (CDRL) require that Technical Data (Drawings) be developed digitally (using CALS specifications MIL-D-28000, MIL-M-28001, MIL-R-28002, MIL-D-28003 & MIL-M-29532) and delivered digitally (using MIL-STD-1840).

Reference: DoDI 5000.2 (9-B)
Guidance: MIL-HDBK-59

2. Does the Production RFP SOW and Technical Manual Contract Requirement require the development of ILS products, such as technical manuals and training materials, using the engineering drawing database as the primary source for illustrations?

Reference: SECNAVINST 5230.X

LOGISTICS SUPPORT ANALYSIS

Milestone I.

1. Does the early LSA strategy reflect CALS methodology?

Reference: SECNAVINST 5000.2

2. Does CALS implementation planning identify the requirement for and the extent to which the LSAR will be maintained throughout the life cycle of the weapon system?

Reference: OPNAVINST 4120.5

3. Does the DEM/VAL RFP SOW and Technical Manual Contract Requirement require the development of ILS products, such as technical manuals, training materials and provisioning documentation, using the Logistic Support Analysis Record (LSAR) as the primary source database?

Reference: DoDI 5000.2 (7-A)

Milestone II.

1. Is the LSAR being used as the primary source database for the development of ILS products, such as technical manuals, training materials and provisioning technical documentation?

Reference: DoDI 5000.2 (7-A)

2. Does CALS implementation planning identify the requirement for and the extent to which the LSAR will be maintained throughout the life cycle of the weapon system?

Reference: OPNAVINST 4120.5

3. Does the EMD RFP SOW and Technical Manual Contract Requirement require the development of ILS products, such as technical manuals, training materials and provisioning documentation, using the Logistic Support Analysis Record (LSAR) as the primary source database?

Reference: DoDI 5000.2 (7-A)

Milestone III.

1. Is the LSAR being used as the primary source database for the development and creation of ILS products, such as technical manuals, training materials and provisioning technical documentation?

Reference: DoDI 5000.2 (7-A)

2. Does CALS implementation planning identify the requirement for and the extent to which the LSAR will be maintained throughout the life cycle of the weapon system?

Reference:

3. Does the Production RFP SOW and Technical Manual Contract Requirement require the development of ILS products, such as technical manuals, training materials and provisioning documentation, using the Logistic Support Analysis Record (LSAR) as the primary source database?

Reference: DoDI 5000.2 (7-A)

SUPPLY SUPPORT

Milestone I.

1. PTDs

MANPOWER, PERSONNEL AND TRAINING

Milestone I.

1. Curriculum development

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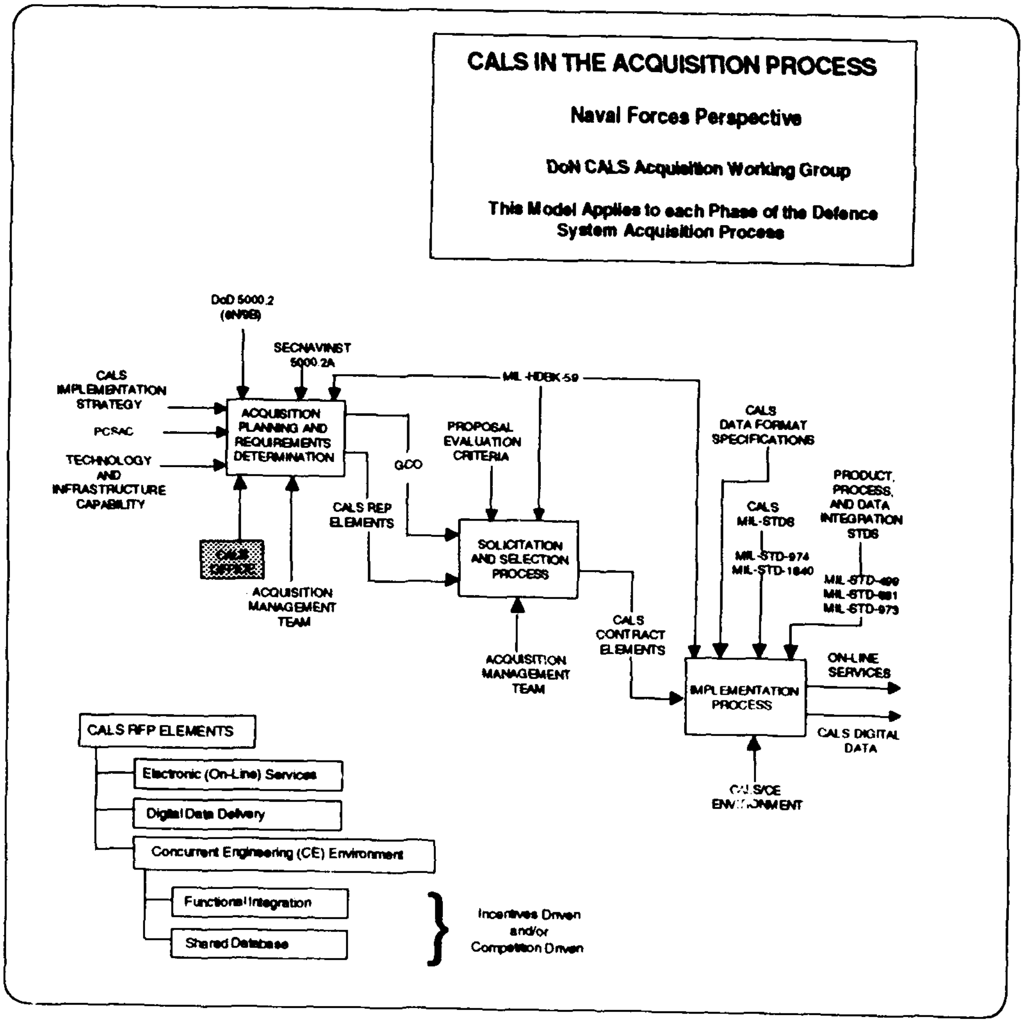
SECTION 11

Points-Of-Contact Listing



CALS POINTS-OF-CONTACT LISTING

1.0 NAVY ORGANIZATIONS

Office of the Chief of Naval Operations
Contact: Cdr. Steve Boyce
Code: N432C
Phone: (703) 695-1338 / AV

Headquarters Marine Corps, D/CS I&L
Contact: Ms. Kathy Chambers
Code: LPS-2
Phone: (703) 696-1074 / AV

Naval Sea Systems Command
Contact: Mr. Steve Weinstein
Code: 04TDC
Phone: (703) 602-1060/1061 / AV 332-1060/332-1061

Naval Air Systems Command
Contact: Mr. Shawn Magill
Code: 41144
Phone: (703) 746-0841 / AV 286-0841

Space and Naval Warfare Systems Command
Contact: Mr. Ernest Weill
Code: 222-3
Phone: (703) 602-6053 / AV 332-6053

Naval Supply Systems Command
Contact: Cdr. Nick Wasilewski
Code: 06A
Phone: (703) 607-0661 / AV 327-0661

Contact: Mr. Hun Kim
Code: 06A1
Phone: (703) 607-2651 / AV 327-2651

Marine Corps Systems Command
Contact: Maj. David Garrard
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Phone: (703) 640-5871/5872 / AV 278-5871/278-5872

Naval Printing and Publishing Services
Contact: Mr. Steve Sherman / Ms. Ann Barns
Code: Defense Printing and Publishing Services, 40
Phone: (202) 433-7416 / AV 288-7416

2.0 NAVY CALS POINTS-OF-CONTACT FOR TECHNICAL AND ACQUISITION SPECIALTIES

2.1 Technical Manuals

Naval Sea Systems Command
Contact: Mr. Phil Hans
Code: 04TD3
Phone: (703) 602-8700 / AV 332-8700

Naval Air Systems Command
Contact: Mr. Gerry Gruden
Code: Naval Air Technical Services Facility, 0128
Phone: (215) 697-1158 / AV 442-1158

Space and Naval Warfare Systems Command
Contact: Ms. Barbara J. Ellis
Code: 222-1B
Phone: (703) 602-8483 / AV 332-8483

Naval Supply Systems Command
Contact: Ms. Joyce DeTolla
Code: 311B
Phone: (703) 607-0908 / AV 327-0908

Marine Corps Systems Command
Contact: Ms. Jean Opavits / Mr. Doug Jones
Code: PSD
Phone: (703) 640-4269 / AV 278-4269

2.2 Interactive Electronic Technical Manuals

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2.4 Technical Data Packages

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Naval Air Systems Command

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Space and Naval Warfare Systems Command

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Marine Corps Systems Command

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3.0 CALS SYSTEM PROGRAM MANAGERS

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Contact: Mr. Richard Claus
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Advanced Technical Information Support (ATIS)

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Authoring Instructional Materials (AIM(T))

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Computer-Aided Design (CAD) 2

Naval Sea Systems Command

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Naval Air Systems Command

Contact: Mr. David Raup
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Naval Supply Systems Command

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Phone: (202) 433-7416 / AV 288-7416

Space and Naval Warfare Systems Command

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Code: 222-3
Phone: (703) 602-6053 / AV 332-6053

Configuration and Logistics Information Program (CLIP)

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Naval Air Systems Command
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Electronic Technical Publishing System (ETPS)
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Engineering Data Management Information and Control System (EDMICS)

Naval Supply Systems Command
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Marine Corps Systems Command
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ICAPS
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Joint Computer-Aided Acquisition and Logistic Support (JCALS)
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Naval Air Systems Command
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Naval Publishing on Demand (NPODS)

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Space and Naval Warfare Systems Command

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Naval Sea Systems Command

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Ships Configuration and Logistics Support Information System (SCLSIS)

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Shipboard Non-Technical ADP Program III (SNAP III)

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Solicitation Package Automation (SPA)

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Technical Manual Print on Demand System (TMPODS)

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Phone: (202) 433-7416
DSN: 288-7416

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

NAVY/MARINE CORPS MANAGER'S DESKTOP GUIDE FOR CALS IMPLEMENTATION

SECOND EDITION
30 JUNE 1993

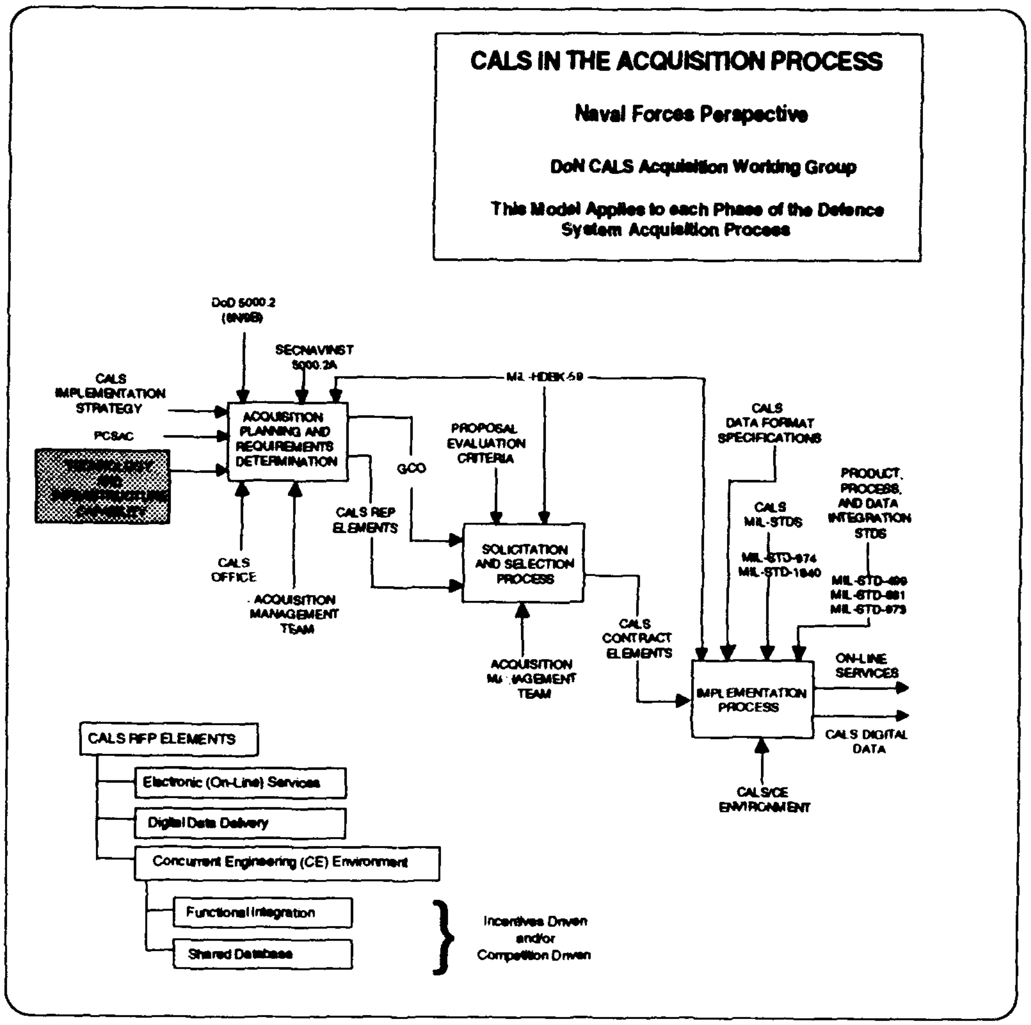
GUIDE CONTENTS

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

SECTION 12

Infrastructure Requirements For The Creation, Management And Use Of Digital Data



INFRASTRUCTURE REQUIREMENTS FOR THE CREATION, MANAGEMENT, AND USE OF DIGITAL DATA

SECOND EDITION

30 JUNE 1993

Prepared by:
CALS Resource and Implementation Cooperative (CALS RIC)

Prepared for:
Navy CALS Acquisition/ Implementation Group

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1.0 INTRODUCTION

The *Navy/Marine Corps Manager's Desktop Guide for CALS Implementation* provides decision templates for selecting the most effective digital data formats and media formats. Digital data includes the technical data package (TDP), technical manuals (TM), and the logistic support analysis record (LSAR). Effective acquisition and use of digital data can only be accomplished with full consideration of the ability of Naval activities to receive, store, distribute, and use the digital data.

DoDI 5000.2, Part 9, Section B states that **"the defense system program office will ensure that all recipients of digital data will have the capability to receive, store, and maintain the provided data."** The materials and equipment required for receiving, storing, and maintaining data constitutes the infrastructure requirements of Computer-aided Acquisition and Logistic Support (CALS). This infrastructure requirement is a key consideration in implementing the CALS strategy on any defense system acquisition. Deficiencies in the Government's infrastructure may require investments by the Acquisition Manager to implement the CALS strategy effectively.

1.1 Scope

Most defense system investment requirements for hardware, software, and telecommunications are within the discretion of the defense system Acquisition Manager. Other infrastructure investments are the responsibility of the supporting Defense Business Operating Fund (DBOF) activities. This document links selected digital data and media formats to the appropriate infrastructure requirements.

1.2 Purpose

This document is intended to provide Navy/Marine Corps Acquisition Managers with an overview of hardware, software, and telecommunications requirements for the creation, management, and use of digital technical data. Section 3 discusses the general considerations and requirements of a computer system infrastructure. Section 4 describes the specific requirements that are dependent on the data type, data format, and user function.

1.3 Infrastructure Resource Planning

The Acquisition Manager should plan to fund an infrastructure modernization program. The Acquisition Manager should plan infrastructure requirements such that funding can be set aside to be used when the infrastructure investment is required. This approach will utilize program funding and resources better. Additional guidance on infrastructure resource planning can be found in MIL-HDBK-59.

2.0 REFERENCES

2.1 Acronyms

A complete list of acronyms used throughout the desktop guide is in Appendix A. The following acronyms are used in this section of the guide.

ADMAPS	Automated Document Management and Publishing System
ADP	Automated Data Processing
AIM	Advanced Industrial Management
ANSI	American National Standard Institute
APPS	Advanced Planning and Packaging Support
ASCII	American Standards Code for Information Interchange
ASIC	Application-Specific Integrated Circuits
ATIS	Advanced Technical Information System
CAD	Computer Aided Design
CAD-2	Computer Aided Design (Second Acquisition)
CALS	Computer-aided Acquisition and Logistic Support
CCITT	Committee for International Telephone and Telegraph
CD	Compact Disk
CGM	Computer Graphics Metafile
CITIS	Contractor Integrated Technical Information Service
CPU	Central Processing Unit
DAT	Digital Audio Tape
DBOF	Defense Business Operating Fund
DoD	Department of Defense
DODI	DoD Institute
DOS	Disk Operating System
DPI	Dots Per Inch
DSN	Defense Support Network
EDIF	Electronic Design Interface Format
FAX	Facsimile
G-byte	Gigabytes
IEEE	Institute of Electrical and Electronic Engineers
IETM	Interactive Electronic Technical Manual
IGES	Initial Graphics Exchange Specification
ILS	Integrated Logistic Support
IPC	Institute for Interconnecting and Packaging
JEDMICS	Joint Engineering Data Management Information and Control System
LAN	Local Area Network
LSAR	Logistic Support Analysis Record
MIS	Management Information System
MRSA	Materiel Readiness Support Activity
NAVAIR	Naval Air Systems Command Headquarters
NAVSEA	Naval Sea Systems Command Headquarters
NEDALS	Navy Engineering Drawing Asset Locator System
NFS	Network File System
PC	Personal Computer
PDL	Page Description Language
PWB	Printed Wiring Board
QIC	Quarter Inch Cartridge

RISC	Reduced Instruction Set Computing
ROM	Read Only Memory
SGML	Standard Generalized Markup Language
SPAWAR	Space and Navy Warfare Systems Command
SPCC	Ships Parts Control Center
TDP	Technical Data Package
TM	Technical Manuals
TMPODS	Technical Manuals Print-On-Demand System
UHDL	UHSIC Hardware Description Language
UHSIC	Ultra High Speed Integrated Circuits
WAN	Wide Area Network
WORM	Write Once Read Many

2.2 Definitions

Definitions used in this section and throughout the Desktop Guide are in Appendix A: Definitions.

2.3 Applicable Documents

Documents referenced in this section and throughout the desktop guide are listed in Appendix A: Applicable Documents.

3.0 GENERAL CONSIDERATIONS

If data users do not have access to the appropriate hardware, software, and telecommunications equipment, working in a digital data environment can become an obstacle rather than an advantage. In the past, Navy/Marine Corps Acquisition Managers have contracted for digital data deliverables only to find an inadequate or nonexisting digital data infrastructure capability. The computer hardware must have the appropriate processing speed and display capability to run the application software adequately. The application software must perform specific tasks on the digital data that are required by the user. Rather than recreate the data, the appropriate computer networking system should allow the users to share data and resources, and telecommunications equipment should allow users to transfer digital data easily.

After reading the first 11 sections of the *Navy/Marine Corps Manager's Desktop Guide for CALS Implementation*, a Navy/Marine Corps Acquisition Manager should have an implementation approach for data type, process, format, and delivery/access method. With this information, infrastructure requirements can be identified. Each decision will affect the life-cycle costs of a program and the cost of the program's computer infrastructure. Human-interpretable data formats, such as page description language (PDL) and raster, may not be suitable as source data for other applications. Processable data formats can be integrated with other digital data to reduce the total life-cycle costs.

The following sections address various topics of consideration for a computer infrastructure:

Computer Architecture
Computer Operating System
Storage Devices
Output Devices
Computer Graphics and Monitors
Network Devices
Application Software
Software Licensing
Network Protocols
Local Area Networks (LANs)
Wide Area Networks (WANs)
Contractor Integrated Technical Information Service (CITIS)

In Section 4.0, Infrastructure Requirements, these topics are used as a basis to discuss the specific hardware, software, and telecommunication requirements of a program. Also included are several decision diagrams to help the Acquisition Manager.

3.1 Hardware Considerations

Computer hardware consists of the computer processor, memory, monitor, storage devices, and input devices. Each computer should be tailored to fit the need of the main application. Computational intensive applications such as mechanical solid modeling or engineering simulation will require a larger amount of memory than general text and 2-D graphics-based applications. Each application requires a distinct amount of hard disk space for data storage. Raster images and simulation models tend to

require more disk space than vector-based databases such as Computer Graphics Metafile (CGM) or Computer Aided Design (CAD) files.

3.1.1 Computer Architecture

Most engineering and business single user computers use either an 80386/80486-based processor, a 68030/68040-based processor, or a Reduced Instruction Set Computing (RISC) based processor. Each computer is designed to meet a specific requirement. In many cases, the computer architecture is driven by the choice of application software needed to perform a specific task. For this reason, the software selected may be the most important decision made.

The 80386/80486 and 68030/68040 personal computers (PCs) are the most widely used computers and are ideal for noncomputational intensive applications that require low- to medium-graphic displays. The RISC workstations are widely used in engineering and technical publishing applications that require either a powerful processor for extensive calculations or a high-resolution graphics display for document editing. A "diskless" RISC workstation may provide a low-cost solution to some engineering computing needs. These workstations typically have a small hard disk for the operating system while the application software and user files are loaded from a server workstation that is connected by a network. A third option is a graphic display workstation that supports the X-window Motif standard. However, a PC with X-window emulation software may provide the same features at a lower cost. The standard options for each type of computer is presented in table 1.

TABLE 1. Standard Options for PC Types

	Personal Computer Type 1	**Windows Workstation Type 2**	**RISC Workstation Type 3**
Processor	386 DX - 33/68030 -	486 DX - 33/ 68040 -	RISC Workstation
Memory	8 Mb	16Mb	32Mb
Media			
Hard Drive	200 Mb	350 Mb	500 Mb
Floppy Drive	3.5 & 5.25	3.5 & 5.25	3.5
Tape Drive	No	Optional	Yes
CD Drive	Optional	Yes	Yes
WORM	Optional	Optional	Optional
Monitor	15"-17" Flat SVGA	17"-19" Flat SVGA	19"-21" High Res
Typical Cost	$1,500 to $8,000	$3,000 to $10,000	$5,000 to $50,000

3.1.2 Computer Operating System

The operating system is the shell that interprets the user's commands and translates them into machine code to control the computer's resources. The computer's internal clock, memory, central processing unit (CPU), terminal, and other peripherals are controlled by the operating system. The three major distinctions among operating systems are the internal throughput bit size, the amount of available memory, and the

ability for multitasking. Each of these factors controls the effectiveness of a computer for a particular user.

Any computer can run an operating system with the same internal bus size or smaller, but the computer cannot run an operating system with a larger bus size. The 80286 and 80386SX computers are only 16-bit computers and cannot be upgraded to any 32-bit operating system. The 80386DX and 80486 computers have a 32-bit internal bus as do most RISC workstations. A few of the high-end RISC workstations have a 64-bit internal bus and will be compatible with a 64-bit operating system.

Two operating systems are available for 80386/80486-based PCs. DOS was the first major operating system for a PC and continues to be the standard. DOS is only an 8-bit or 16-bit operating system and does not offer true multitasking. OS/2 was introduced a few years ago and offered users multitasking and a 32-bit operating system. Windows NT is similar to System 7, discussed in following paragraph, and offers many advantages compared to DOS. The largest benefit is that Windows NT will be available on PCs and RISC-based workstations. This will allow the engineering users access to the same application software on a RISC workstation that most business users have on a PC.

A popular operating system used for the 68000 series processor is System 7, which is a true windowing system with 32-bit multitasking capabilities. This operating system has attained popularity due to its ability to meet the demands of both beginner and expert computer users. The operating system has strict hardware/software standards that reduce compatibility and installation problems. However, the cost of such systems is generally 10-20 percent higher than similar Windowing systems.

Most RISC workstations currently have a UNIX operating system based on System V UNIX or Berkeley BSD 4.4 UNIX that is POSIX compliant. Each operating system provided with RISC workstations is unique, but most will run application programs that were compiled using System V or Berkeley BSD UNIX. Both the Automated Document Management System (ADMAPS) and CAD-2 program specified a POSIX operating system with a Motif standard graphical user interface.

Three new POSIX-compliant operating systems have just been released or will be in the next year. OSF/1.0, OPEN VMS, and Windows NT are new operating systems that are designed to allow users a greater variety of application software. Windows NT is designed to allow users of the RISC-based computer and 80486-processor-based-computer to run the same operating system and the same versions of application software.

3.1.3 System Backup

System backup is very important to the Acquisition Manager. If managed properly, systems can be designed such that even a catastrophic loss of data can be recovered in a relatively short period of time. To do this, the Acquisition Manager should address areas such as hard drive or CPU failure, lightning strike, fire, or damaging storm in a disaster recovery plan.

Backup of a system should include a practical means to back up system data. This is a function that should be easy to accomplish and convenient to the users. If a system

does not have a convenient backup system, the user will be unlikely to back up regularly and, thus, risk catastrophic loss of program data. An acceptable means to archive system and program data is to use a tape backup system.

3.1.4 Physical Media

Each computer system needs the appropriate amount of data storage capacity to allow users access to all areas of project data. This disk space can reside on each computer or on a network file server. Storage technology is constantly changing, and the Acquisition Manager should understand that the physical media addressed below is provided as a guideline but does not necessarily imply that only the following technology should be used in building infrastructure. When evaluating whether to use new technology, the Acquisition Manager should assure compatibility with other equipment of the same technology or with older, less sophisticated media. Figure 1 displays samples of physical media.

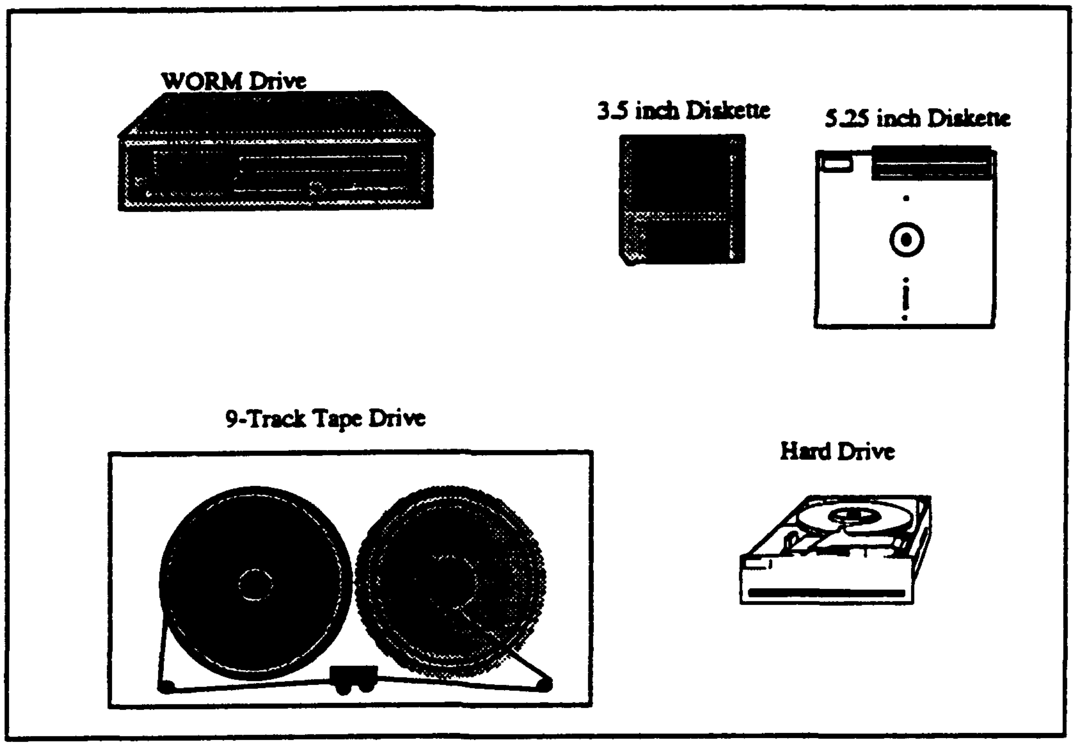


FIGURE 1. Examples of Physical Media

3.1.4.1 Magnetic Media

Magnetic disk drives are available for most computer systems. Magnetic disk drives can store from 200 to 4,000 megabytes and should be ANSI SCSI or IDE compatible. SCSI provides compatibility and allows for expansion when greater disk space is required. Magnetic disks can be used to transfer data when required. The most common magnetic disk to transfer data is the 3.5 inch and 5.25 inch magnetic disk. The 5.25 inch can hold up to 1.2Mb of data, and the 3.5 inch can hold up to 1.44Mb. Using magnetic disks to transfer data should only be considered when the total data does not exceed 10Mb.

When transferring over 10Mb of data, a 9-track computer tape or Quarter Inch Cartridge (QIC) tape would be better suited (MIL-STD-1840). The standard 9-track tape can store approximately 240Mb of data compared to 500mb with the QIC. The exact configuration of the tape format can greatly affect the capacity of the tape. Tape drives that accept tape cartridges are easier to obtain and integrate into a desktop computer system. However, the Acquisition Manager should confirm that tape formats are compatible.

An alternative technology to 9-track tape or an optical drive (paragraph 3.1.4.2) is the Digital Audio Tape (DAT) drive. DAT drives can store up to 5 Gigabytes (Gbyte) of data. The tapes are small and are easily integrated into the desktop environment. This avoids capacity problems that are sometimes encountered in 9-track and optical drives.

3.1.4.2 Optical Media

Optical drives are readily available and come in many different types and sizes. The most common optical drive is the 5.25 inch Compact Disk (CD) Read Only Memory (ROM) drive. These drives are used for end user systems similar to Advanced Technical Information System (ATIS). A Write Once Read Many (WORM) optical disk system should be considered for storing the final deliverable digital data for a large project. Optical disks can store up to 200 Gbytes. This will provide the project with a nonerasable copy of the data that can help in configuration control. However, all WORM optical disk systems do not produce the same format as CD, and compatibility with the end user should be verified.

3.1.5 Output Devices

Each computer user will need access to a printer and/or a plotter. These devices can be set up on a LAN rather than directly to a specific computer, so that network users can share the devices. Printers are generally used to produce "A" or "B" (ANSI Y14.1-80) size documents. Plotters are used to create up to "J" size documents. Aperture card plotters are also available and are used to plot the image to an aperture card and inscribe the aperture cards keypunch data.

An "A" size PostScript compatible laser printer is the standard printer recommended for general use. The printer should have a minimum resolution of 300 by 300 Dots Per Inch (DPI) and a minimum print speed of four to eight pages per minute. An "A/B" size laser printer would be better suited to print engineering drawings. Most drawings are legible when printed on "B" size paper.

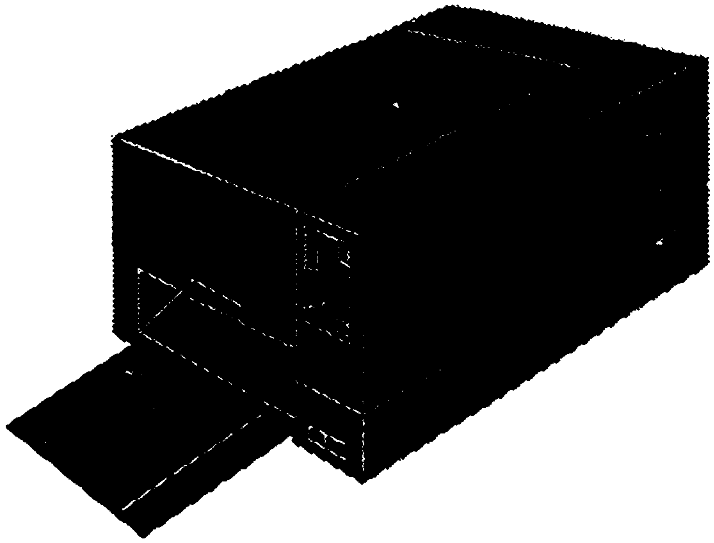


FIGURE 2. Standard Laser Printer

The two main types of plotters are electrostatic and pen plotters. Electrostatic "E" size plotters are recommended for engineers involved in the creation and review of engineering documents or when there is a requirement to plot up to "E" size raster drawings. A pen plotter may suffice, but these plotters can take up to 30 minutes to print a vector drawing versus only 1 to 2 minutes for an electrostatic plotter. Pen plotters cannot be used to plot raster images. Electrostatic plotters generally cost between $5,000 and $12,000; pen plotters cost about $4,000.

3.1.6 Computer Graphics and Monitors

The resolution and monitor size are important considerations when choosing the proper monitor. Most users who work with graphical data such as engineering drawings or technical illustrations will be more efficient with a high-resolution, 19-inch monitor. This is especially true when working with raster files. A larger monitor may eliminate the need to zoom in on a section of the drawing or illustration. A 14- to 16-inch monitor is suited only for general Windows applications and is not recommended for reviewing drawings or illustrations.

An option for some RISC-based workstations is real-time, 3-D graphic manipulations. This allows the user to rotate and/or scale the view of the object in real time. Any engineer performing solid modeling or finite element analysis will increase productivity on the workstation with this option. Screen redraws for complex images can take up to several minutes with a standard graphics option but can be performed instantaneously with the 3D graphic processors.

3.1.7 Network Devices

Network devices include equipment that is required to connect a single user station to an existing network or to connect two or more networks together. Examples of this type of equipment usually are network cards, bridges, and routers.

The basic requirements to create a single LAN are an Ethernet board for each computer and the coaxial or twisted-pair cable to connect each computer. Network bridges can be added to the LAN, to connect to other LANs or manage the LAN electronic message traffic. Network terminal servers allow terminals, modems, and printers to be connected into the LAN. Network routers enable remote LANs to be connected or the LAN to connect to a WAN. All network devices should support the Ethernet V2.0 and IEEE 802.3 standards. Due to LAN configuration complexity and variety, the Acquisition Manager should discuss infrastructure requirements with the supporting activity Automated Data Processing (ADP) manager before purchasing any LAN equipment.

3.1.8 Input Devices

There are many different ways to provided input to a computer system. One of the most basic input devices is a keyboard. There are many different arrangements; however, the industry standard is the 101-key type. Additional devices include mice, track balls, digitizing tablets, light pens, and scanners. With the exception of the scanner, all the previous devices generate data with the user's guidance.

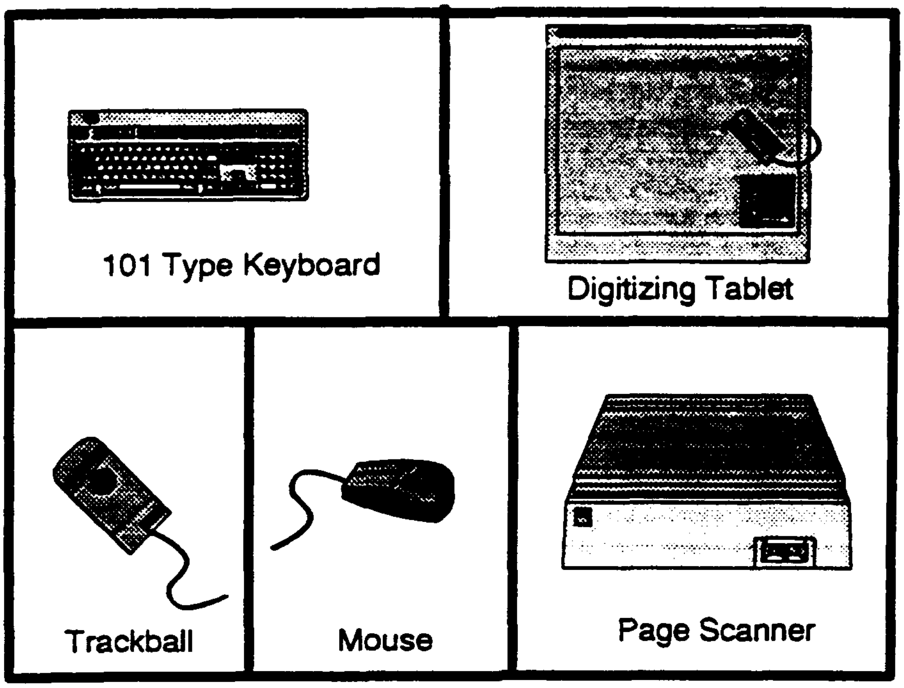


FIGURE 3. Examples of Input Devices

The technology of scanners has greatly increased in the past few years and can add speed in the generation of technical data. Scanners can have many features including color, gray scale, line art, and a host of others. As a general rule, the more features and higher detail of the image, the more disk space is required. There are definite ranges where there is a point of diminishing return comparing quality of image vs. size of image. Attention should be made to this aspect, because, not only will a large image consume a large amount of disk space, but it will also slow the speed of the computer when the graphic is to be displayed. There are many different types and sizes of

scanners available to the Acquisition Manager. The two basic types of scanners are page scanners and large-format scanners.

Page scanners are designed to be implemented with text or graphics up to 8.5 by 11 inches. When scanning images for documents that are currently being created or updated, a single-page scanner should work well. Features for a single-page scanner include quality of scan and moderate speed. Sheet-fed scanners are generally used to archive large amounts of paper data. The features required are speed of scan and moderate resolution.

Large-format scanners are used to generate raster images from paper drawings up to 60 inches wide with an unlimited length. The scanners are monochrome/gray scale and are a single-sheet feed operation. In recent years, the speed and cost have been significantly reduced while quality has been enhanced. Large-format scanners can provide a means of converting old, deteriorating paper drawings into an electronic form that can be edited and restored, if required. Although the cost has been reduced significantly, a large-format scanner is a major investment and is usually purchased by the software support activity as a shared resource.

3.2 Software Considerations

The Acquisition Manager must consider how a specific software application fits into the complete data process. Configuration management software may be needed to control the access and revision of digital data files as well as the specific application software. Software applications available through Navy infrastructure modernization programs (see Appendix C) should be considered before different software applications are examined. Another important question is whether the software import and export files are in a CALS format such as MIL-D-28000 IGES and MIL-M-28001 SGML. This will ensure the data will be accessible by other users.

3.2.1 Data Formats

Digital data deliverables available in the CALS environment are extensive. Each Navy/Marine Corps Acquisition Manager must evaluate the need to determine which format is appropriate at each stage of a specific program. The final deliverables must be in a standard CALS format while preliminary digital data may be in a format that is agreeable to the Acquisition Manager and the contractor. Commercial word processing software with the capability of text attribute, style sheets, and imbedded graphics may be used to view and annotate preliminary TMs. A list of various digital data formats is shown in table 2.

The Acquisition Manager must consider who is going to use the data in the fleet and ensure that the infrastructure matches each user's requirements and the function of the requirements.

TABLE 2. Standard Digital Data Formats

Standard Digital Data Formats:
MIL-D-28000 IGES /CALS
MIL-M-28001 SGML /CALS
MIL-R-28002 Raster graphics /CALS
MIL-D-28003 CGM for illustration data /CALS
Formatted ASCII text
Page Description Language POSTSCRIPT
VHSIC Hardware Description Language (VHDL) /BBS
Electronic Design Interchange Format (EDIF) /BBS
IPC-D-350 /BBS
Native CAD format

The required infrastructure will vary depending on the data use and the data format. Formats, such as MIL-R-28002 Raster, will require a higher resolution monitor but less processing capability to view and modify compared to a solid-model-based CAD system. Raster and MIL-D-28000 IGES data formats generally necessitate larger disk memory. Some data functions cannot be performed on all digital data formats.

3.2.2 Operating System Compatibility

The first consideration is which operating systems the program uses. The operating system variations are described in 3.1.2. A software application that supports both disk operating system (DOS) for the PCs and UNIX for the RISC-based workstations will allow greater flexibility than a program tied to a single operating system. This is especially true when business and engineering personnel need to review the digital data. Most business applications operate on a PC while most engineering applications operate on RISC-based workstation.

X-window emulation software may solve some problems. The current generation of X-window emulation programs are quite robust and can be used to allow PC users access to UNIX X-window software from a PC. The PC emulation packages for RISC-based workstations are not as sophisticated as the X-window emulation programs.

3.2.3 Application Packages

General types of packages

TABLE 3. General Types of Application Packages

Computer Software	Capabilities	Examples
Word Processing	Creating Text-Based Documents	Documents
Spread Sheet	Calculations Data Manipulations Chart and Graphs	Financial Reports Engineering Calculations Data Reports
Desktop Publishing	Advanced Text and Graphics Integrated Documents	Advanced Documents and Publications
Mathematics	Symbolic Calculations Advanced Calculations 2-D, 3-D Plots	Engineering Calculations Technical Reports
Terminal Emulation	Emulates Specific Terminals for PCs	X-Window Emulation on a PC
MCAD	3-D Solid Modeling Mechanical Drawing	Weapon System Models Ship Drawings
Schematic Capture	Electrical Schematic Logic Checking	Wiring Diagrams Avionics System Designs
Printed Wiring Board (PWB) Layout	PWB Layout PWB Manufacturing Data	Computer Aided Manufacturing
Finite Element Analysis	Structural Simulation Vibration Simulation Thermal Simulation	Flight Safety Checks Cooling Systems Evaluations
Dynamic Simulation	Mechanism Simulation Dynamic System Simulation	Bomb Rack Mechanism Evaluations Vehicle Characteristic Simulations
Electrical Simulation	VHDL Analog Simulation ASIC Simulation	Computer Aided Engineering

3.2.4 Software Licensing

The type of software licensing available can affect the total cost to implement a software system. The four types of software licensing that are prevalent today are single-user license, single-computer license, network license, and a site license. Each

licensing option has a proper use and can greatly affect the total life-cycle costs associated with the software procurement.

A single-user license allows the software to be loaded on one computer, and one person has access to the program at a time. Most PC software programs are licensed to a single user. A single-computer license is licensed for a specific computer, and the vendor may charge to move the license to a different computer. This type of license can allow either a single user or multiple users access to the program. The multiple-user option is generally used when the software is operating on a mainframe computer or network server.

A network license will allow a specific number of simultaneous users, who share a common network, access to the program. Single-computer and network licenses are usually offered on software available on UNIX workstations. These licenses can reduce the total cost of supplying the needed software for all of the users of an acquisition program.

A site license allows the software to be used on any computer at a particular location.

3.3 Telecommunications

The standard equipment required for telecommunications is a modem. The modem is used to link two or more computer systems via a phone line. Normal uses could include connection to larger computer systems via a terminal emulation program, connection to a remote site to send/receive files, or to access CITIS. A more specialized modem that has become readily available is a modem capable of sending and receiving FAX data as well as the standard CCITT (Committee for International Telephone and Telegraph) information.

The speed requirement of the modem is directly related to the size of the data files that will be transferred and frequency that the modem will be used. If data is only to be accessed and viewed remotely using a terminal emulation program, then a 9,600 baud (character per second) modem is probably acceptable. However, if there is a requirement to send/receive large data files, a faster modem with built-in data compression is required. Before purchasing a modem, the Acquisition Manager should assure compatibility with the remote location.

3.3.1 Network Protocols

Network protocols are essentially the software standards that enable users to communicate over LANs or WANs. There are several types of network protocols that are acceptable in the CALS community. Factors to consider when choosing the type of network protocol needed include current facility LAN/WAN compatibility, interface requirements, data to be transferred, and distance of network. The following are common protocols and their capabilities.

- GOSIP: The Government Open Systems Interconnection Profile (GOSIP) is the Government standard for networking protocols. Its function is to provide interoperability among different equipment manufacturers (FIPS PUB 146-1).

- TCP/IP: This is the general protocol (IEEE 802.3) for most engineering workstations and servers. It allows UNIX computers to connect to each other for remote login with rlogin and rsh UNIX commands. It also allows a PC with X-windowing software to establish an X-window session on a UNIX server.

3.3.2 LAN

A LAN is required when there are several users who need to share data, application software, and equipment. The LAN network devices are commonly printers, disk drives, modems, and other Management Information System (MIS) equipment. As the name LAN suggests, this type of network is contained within a small area (usually within the same building or floor).

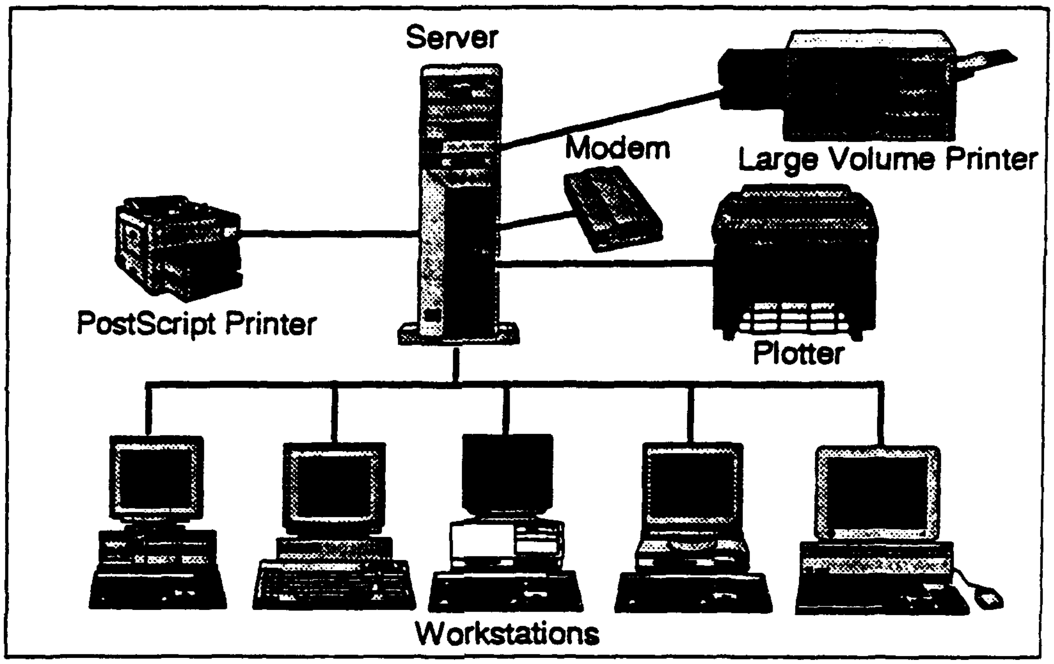


FIGURE 4. Example of Basic LAN Layout

LANs are based on the needs of the user. Some LANs may only .ieed to be connected to share resources such as modems or printers. Another LAN function could be used for configuration management of large CALS databases.

A common need for organizations is to transfer data from one LAN to another or to connect to a large mainframe computer. These functions can be achieved with what is commonly referred to as a bridge.

3.3.2.1 LAN Application Software

NFS (may come with UNIX operating system) allows network file transfer and a file server's storage device to become a local device transparent to the user available on the PC.

3.3.3 WAN

A WAN is required when there are several users who need to share data or equipment over a large area (usually many miles). A WAN should only be considered if there is a need to transfer large amounts of data for long periods of time. If occasional or limited use of access to remote data or equipment is needed, then a modem will suffice.

There are several Government WANs that can be accessed by the CALS community. These networks include NAVNET, DSN, and Internet.

3.4 Data Processes

The Navy Acquisition Manager needs to determine what digital data functions are required and who is the data user. The infrastructure may vary for each use of the data, if the hardware, software, and network cost are to be minimized. Generally, certain data functions are performed with a specific format. Conversion software may need to be procured to ensure that the format of the data is also compatible with the end user's requirements. The user functions are divided in the following areas.

- View: Acceptance, verification, and review of acquired digital data sets.
- Comment/Annotate: Annotate or highlight for future reference, or make annotations and comments without the ability to change the original file. The annotations are associated with a specific item or location within a document.
- Update/ Maintain: Update and modification of digital data.
- Process/Transform: Categorize, extract, cross-reference, and modify the format, composition, and structure of the data into another usable form.
- Archive: Storage of the accepted data into a repository, managed by a central index or locator.

4.0 INFRASTRUCTURE REQUIREMENTS FOR PROCESSING DIGITAL DATA

4.1 Introduction

The following section contains information to aid the Navy/Marine Corps Acquisition Manager in determining the infrastructure needed to process digital data. Digital data includes the TMs, TDP, and the LSAR. TMs are any technical publication or other form of documentation used to install, operate, maintain, test, repair, and overhaul equipment or to provide logistic support for ships, aircraft, defense systems, or defense materiel. The TDP contains the information necessary to describe a defense system and its components in terms of design, engineering, manufacturing, and logistic support. LSARs contain the information necessary to describe a defense system and its components in terms of design, engineering, manufacturing, and logistic support.

The current user infrastructure, as well as any applicable Navy or Department of Defense (DoD) modernization programs, must be considered in any decision to procure new computer equipment or software. Navy Acquisition Managers should give preference to the Navy's infrastructure modernization programs over general DoD infrastructure programs and general procurements.

4.2 Infrastructure Modernization Programs for Digital Data

The Navy infrastructure modernization programs for digital data are designed to be implemented at the support activity and are typically funded through the DBOF. Due to the cost of the equipment and software required for the Navy Infrastructure Modernization Programs, these systems are made available to the Acquisition Manager as a shared resource. The Acquisition Manager should be familiar with the systems available and the system requirements needed to facilitate compatibility between the software support activity and the local Acquisition Manager's digital data infrastructure. The following paragraphs provide an overview of what infrastructure modernization programs are available. See Appendix C for greater detail on infrastructure modernization programs.

4.2.1 Navy Infrastructure Modernization Programs for TMs

The following Navy infrastructure modernization programs are designed to aid in the creation, management, and use of digital TMs.

- Automated Document Management and Publishing System (ADMAPS): ADMAPS is a contract vehicle to provide a CALS-compliant (ASCII/SGML) publishing system for the acceptance, verification, creation, and updating of TMs and other Navy documentation. ADMAPS serves as a front-end processor to transport TMs to TMPODS.

- Technical Manuals Publish-On-Demand System (TMPODS): TMPODS stores Navy TMs in CALS-compliant digital format and provides for the production and delivery on an as-needed basis. TMPODS stores the manuals in raster format with TM indexing, and SGML TMs are processed through ADMAPS, which will support IETMS. It includes the capability to print TMs in book form or to produce in digital format on optical media.

- Advanced Technical Information System (ATIS): ATIS is a presentation system designed to place current and accurate digital technical data into user hands. ATIS allows engineers to access technical documentation, retrieve it from a digital repository such as JEDMICS and TMPODS, and create technical information files containing repair/planning data.

4.2.2 Navy Infrastructure Modernization Programs for TDPs

The Navy infrastructure modernization programs designed to aid in the creation, management, and use of digital TDPs are:

- Computer Aided Design (Second Acquisition) (CAD2): The CAD-2 program is intended to meet the Navy's need to continuously improve its engineering design, manufacturing, and maintenance capabilities.

- Joint Engineering Data Management Information and Control System (JEDMICS): JEDMICS is the joint services "digital warehouse" for engineering drawings and related technical data. It will accept drawings and related data in standard digital form or will digitize drawings and data from hard copy. The system indexes, stores, and retrieves the data digitally and can distribute it in several ways including paper, disk, and CD-ROM.

- Navy Engineering Drawing Asset Locator System (NEDALS): NEDALS is an automated indexing and ordering system for all NAVSEA, NAVAIR, SPAWAR, and SPCC engineering drawings.

- ATIS: Refer to 4.2.1.

- Advanced Industrial Management (AIM): AIM is a major Naval shipyard initiative to change the functional process for ship maintenance and repair management by improving the shipyard's ability to plan, estimate, and schedule work. AIM consists of the ATIS module and Advanced Planning and Packaging Support (APPS). The APPS module will create work packages from the technical information in ATIS. This information is used to package and manage shipyard work by work-task planning, packaging, schedule control, status tracking, work certification, material support, and documentation distribution.

4.2.3 Navy Infrastructure Modernization Programs for Integrated Logistic Support (ILS)/Logistic Support Analysis Record LSAR

The Navy infrastructure modernization programs designed to aid in the creation, management, and use of digital LSARs are:

- Material Readiness Support Activity (MRSA) Certified LSAR Software: There are several commercially available LSAR software packages. These packages can generate electronic LSAR as well as reports in ILS reports. The Acquisition Manager should consider purchasing multi-user software licenses when there will be multiple users of the LSAR data. For a complete listing of MRSA certified software packages, please contact MRSA directly.

- AIM: Refer to 4.2.2.

4.2.4 DoD Infrastructure Modernization Programs for Digital Data

Joint Services/Defense Logistic Agency Computer-aided Acquisition and Logistic Support (JCALS): The JCALS program is the DoD joint services initiative to modernize the processes for the capture, storage, and processing of logistic technical information required for weapons systems acquisition, design, manufacture, and support. Logistic technical information will be linked through communication networks to facilitate data sharing by authorized users. JCALS will allow authorized users throughout DoD to access on-line electronic information resident in a JCALS integrated weapons system database.

4.3 Hardware Requirements for Processing Digital Data

4.3.1 Hardware Requirements for Processing TMs

The hardware requirements for processing TMs are dependent on the specific requirements of the user. Table 4 displays the specific requirements.

The archive requirement for processing TMs is provided by the TMPODS system. However, if the Acquisition Manager chooses to retain a separate archive master, the suggested system hardware on table 4 provides TM archive capability.

The view only function requires the basic equipment to reference TMs. The equipment can be as simple as a machine that can display ASCII characters or as complex as reading CD ROM over a network. The hardware in table 4 displays the equipment required for accessing TMs from a CD ROM.

The comment/annotate function for processing TMs is used primarily during the review process prior to and during validation. The comment/annotate function is still present on systems such as Interactive Electronic Technical Manuals (IETMs). This is to allow technical personnel the capability to include additional information, if required. To accomplish this task, there must be a link between CD ROM data and additional information stored remotely. If there is no direct link between the CD and the additional information, then there is no requirement to supply CD ROM drives with a system required to comment/annotate TMs.

The hardware requirements for updating and maintaining TMs include the capability to work with tagged SGML documents. The system requirements for using an SGML editor can be found in table 4. Specific requirements, including CD ROM, scanners, and WORM drives, should be addressed on a case-by-case basis depending on the type and amount of data being processed.

The hardware requirements for extracting, processing, and transforming TM data depend on the data being generated. The TM can be generated in a commercial editor and translated into SGML at a later time. This can reduce the infrastructure requirements if there is a basic infrastructure already in place. If the requirement is to transform an approved TM into an IETMS, then the hardware should reflect standard IETMS equipment.

TABLE 4. Matrix of Infrastructure Requirements

	386 DX-33	486 DX-33	RISC	RAM	HARD DRIVE	MONITOR	SCANNER	CD ROM	WORM	TAPE DRIVE	WORD PROCESSOR	SGML VIEWER	DATABASE	SPREADSHEET	GRAPHICS/RASTER	GRAPHICS/VECTOR	ILS/LSAR	NETWORKS	PRINTERS	PLOTTERS
Process Technical Manuals																				
Archive		X	(TMPODS)	16Mb	325Mb	15"-17"	x		x	x	x		x		x	x		X	X	
View Only	x			16Mb	200Mb	15"-17"		x			x	x			x			X		
Comment/Annotate		x		16Mb	200Mb	17"-19"				x	x	x			x	x		X	X	
Update/Maintain			x	32Mb	500Mb	17"-19"	x		x	x	x		IETMS		x	x		X	X	
Extract/Process/Transform		x		32Mb	500Mb	17"-19"	x	x	x	x	x		IETMS	x	x	x		X	X	
Process Technical Data Packages																				
Archive			x	32Mb	200Mb	19"-21"	x			x	x		x	x	x	x		X	X	X
View Only		x		32Mb	200Mb	19"-21"		x		x	x				x	x		X		
Comment/Annotate		x		32Mb	500Mb	19"-21"		x		x	x		x		x	x		X	X	X
Update/Maintain			x	32Mb	500Mb	19"-21"	x		x	x	x		x	x	x	x		X	X	X
Extract/Process/Transform			x	32Mb	600Mb	19"-21"	x	x	x	x	x		x	x	x	x		X	X	X
Process ILS/LSAR																				
Archive	x			8Mb	200Mb	15"-17"				x	x		x		x		x	X	X	
View Only	x			16Mb	500Mb	15"-17"				x	x		x		x		x	X		
Comment/Annotate		x		32Mb	500Mb	15"-17"				x	x		x		x		x	X	X	
Update/Maintain		x		32Mb	500Mb	17"-19"				x	x		x			x	x	X	X	
Extract/Process/Transform		x		32Mb	500Mb	17"-19"				x	x		x	x		x	x	X	X	

4.3.2 Hardware Requirements for Processing TDPs

Two decisions that affect the hardware requirements are whether the final engineering drawings will be stored in the native CAD files or an equivalent vector format versus raster and whether the engineers will be performing simulation. Raster data does not allow the ability to utilize the data for engineering analysis; thus, the processing requirement to work with only raster data can be significantly less than with processable vector format, such as Initial Graphics Exchange Specification (IGES) or VHDL.

Processing TDPs with raster is limited to changes that would be accomplished on a paper or 2-D drawing. This type of processing could make basic changes relatively quickly and easily. However, modeling and simulation are best suited for 3-D vector data.

The hardware requirements differ among the disciplines of engineering required to be processed. There are some basic commercial IGES drawing packages that can produce 3-D models on an 80486 computer. If the Acquisition Manager plans to simulate the stresses of a mechanical part or the multilayer printed circuit board (PCB) layout, a RISC-based workstation should be considered. In addition to the basic workstation, the Acquisition Manager should address the procurement of the following equipment:

- Database Server (required for large, drawing databases)
- MIL-STD-1840 tape drive (standard for large, data delivery)
- Other media drives, including DAT, cartridge tape, and QIC (provide large storage capacity)
- PostScript printer (required for A size drawing and documentation)
- A to D size electrostatic plotter (large volume of drawings or for raster drawings)
- A to D size pen plotter (low volume vector drawings)

4.3.3 Hardware Requirements for Processing ILS/LSAR

The specific hardware requirement for processing ILS/LSAR is directly dependent on the software requirements. Several configurations can be made depending on the number of users who need to access LSAR data. With multiple users sharing data, it is recommended that a LAN-based LSAR system be installed. However, if the need is for a single user only, refer to table 4 for a guideline of the equipment required.

4.4 Software Requirements For Processing Digital Data

The software requirements for processing digital data will be dependent on how the digital data is received: on magnetic, via LAN/WAN or modem, or by other data transfer means. All of these options will carry with them specific software needs and operating system requirements. The Acquisition Manager should procure systems that are compatible with not only end user output requirements but also with both known and possible future digital data sources.

4.4.1 Software Requirements For Processing TMs

Once the program logistics support agent has determined the need for a TM and the TM manager agent has completed the Technical Manuals Contract Requirements (TMCRs), the typical TM creation process consists of authoring, reviewing, updating, and inspecting the technical manual or publication. Each program can accomplish these tasks by various methods.

The first decision the Navy/Marine Corps Acquisition Manager must decide is whether the TM will be an illustrated text data file technical manual or an IETM. This decision, along with the data use and the data format, will determine the specific infrastructure individuals involved will require in the creation, management, and use of a TM.

4.4.1.1 Software Requirements For Creating SGML Format TMs

The preliminary TM may be authored in a variety of software programs. Commercial word processing software, desktop publishing software, or an SGML editor all have ability to author technical documents with imbedded tables and figures. Therefore, the Acquisition Manager must ensure that the TM reviewers have software compatible with the contractor's TM-authoring software unless the contractor is providing the view and annotate with a CITIS. The TM reviewer must be able to view and annotate the TM file rather than edit the existing file. Once the preliminary version is complete, commercial software is available to convert a word processing or desktop publishing document into a MIL-M-28001 SGML format file. These programs try to add all the appropriate tags to the SGML text file.

If the preliminary TM is in SGML format, several options exist to allow users to view and annotate the manual. Low-cost SGML document editors are available for PCs and UNIX workstations. PDL viewers and annotator translators can be purchased to convert the entire SGML file into raster format, word processing file formats, and desktop publishing file formats.

Network software licensing and data translators can minimize the cost of procuring the required software products. Since most users involved in the review of a TM will not be needing an SGML editor all the time, a single network license may provide five to ten users access to the software. As a final option, translators can also be purchased to convert the document format into a format compatible with their existing software. Data files can be translated among SGML and raster format, word processing file formats, and desktop publishing file formats. A complete list of possible translations among data formats is listed in table 2.

4.4.1.2 Software Requirements For Creating IETMs

The preliminary IETM may be developed in a commercial word processing software or SGML editor. Once the preliminary version is complete, the data must be converted such that a Hypertext system can retrieve the data and display the information requested. ITEMs should be developed on systems that are capable of executing complex graphical user interface processes without delay.

4.4.1.3 Software Requirements For Managing TMs

Once the final reproducible copy of the TM is accepted, the cognizant life-cycle maintenance activity is responsible for the configuration management of the document. To properly implement configuration management, the following software packages should be available to the configuration manager.

- SGML editor
- DTD editor
- Illustrator editor for vector and raster
- Configuration management database

4.4.1.4 Software Requirements For Using TMs

The software requirements for using TMs are based on the user's receiving electronic data containing the TM and having the needed software to utilize the TM. Depending on the format that the TM was delivered in, the end user could require any part of the following software to utilize the TM.

- PDL viewer and annotator
- SGML parser to extract,
- Illustrator editor for vector and raster
- Database query application

4.4.2 Software Requirements For Processing TDPs

The first decision that affects the software requirements is whether the final engineering drawings will be stored in the native CAD files or an equivalent vector format versus raster. Raster data does not allow the ability to utilize the data for engineering analysis; thus, the processing requirement to work with only raster data can be significantly less than with processable vector format, such as IGES or VHDL.

4.4.2.1 Software Requirements For Creating TDPs

The software requirements for creating TDPs can be in several formats. The specific format used depends on the type of data being generated and the way the data will be managed throughout its life cycle. The following formats may be used.

- Native CAD
- CAD-2
- IGES view
- FEM (VHDL simulation)

4.4.2.2 Software Requirements For Managing TDPs

Managing the TDP after its distribution to the fleet will entail all of the same software requirements needed during its creation. The following list of software applications may be required to meet these needs.

- CAD-2
- Fluid flow analysis
- PWB layout
- SPICE simulator
- VHDL simulator
- PLD software
- Hybrid/Application Specific Integrated Circuit (ASIC) software
- Configuration management
- Relational database

4.4.2.3 Software Requirements For Using TDPs

The requirements for using TDPs are limited by the fact that users will not edit or change the content of the TDP. Therefore, only the software necessary to view and print the TDP data will be required. This will then depend on the type of TDP being used and the formats in which it was distributed. The manager will have to determine what TDP formats are likely to be encountered and develop a system appropriate to the end users' requirements. This will include all or part, but not limited to, the following programs.

- IGES translators
- Configuration management
- Relational database
- CAD-2 - PWB layout

4.4.3 Software Requirements For Processing LSARs

The Acquisition Manager will be required to assure that any software used to process LSAR data is certified by MRSA and meets MIL-STD-1388

4.5 Telecommunications Requirements for Processing Digital Data

The telecommunications requirements for processing digital data have been briefly discussed in section 3. These requirements should be based on how data is to be shared or manipulated and what current telecommunications infrastructure is available.

Specifically, the Acquisition Manager should determine the average number and size of data transfers to determine the type and size of the communication systems needed. Considerations are the number of modems or outside lines being supported, baud rate of the modem, error detection/correction performance, and compatibility to data sources. Will the telecommunications system be installed using standard, conditioned, trunk, or uninteruptable lines, or will fiber optics be used, if available? Once the data is coming into the facility, how and where will it be stored, and will other outside sources be allowed access? All these factors need to be given careful consideration. The initial decisions will affect the current operation and future expansion of the system.

5.0 CONTRACT VEHICLES FOR INFRASTRUCTURE REQUIREMENTS

There are many options an Acquisition Manager can invoke when acquiring digital infrastructure. Depending on the type of equipment required, the Acquisition Manager can use existing Government contracts to acquire equipment. It is important that the Acquisition Manager work closely with their local ADP or FIPS manager when making equipment purchase decisions. The ADP or FIPS manager is cognizant of their facility's current technology and standards. This can result in cost saving compared to commercial low bid or GSA pricing. An up-to-date listing of the US Navy and DoD umbrella contracts can be found on NC TAMS LANT on-line Bulletin Board System (BBS). Access can be made, initially, to view current contracts as well as contracts in progress. The telephone number for the BBS, OASYS are as follows:

(804) 445-1127
(804) 445-1627

The communication parameters are up to 9600 BPS with 8-1-N as the communication parameters.

If file transfer is required, please contact the following group for formal access upgrade:

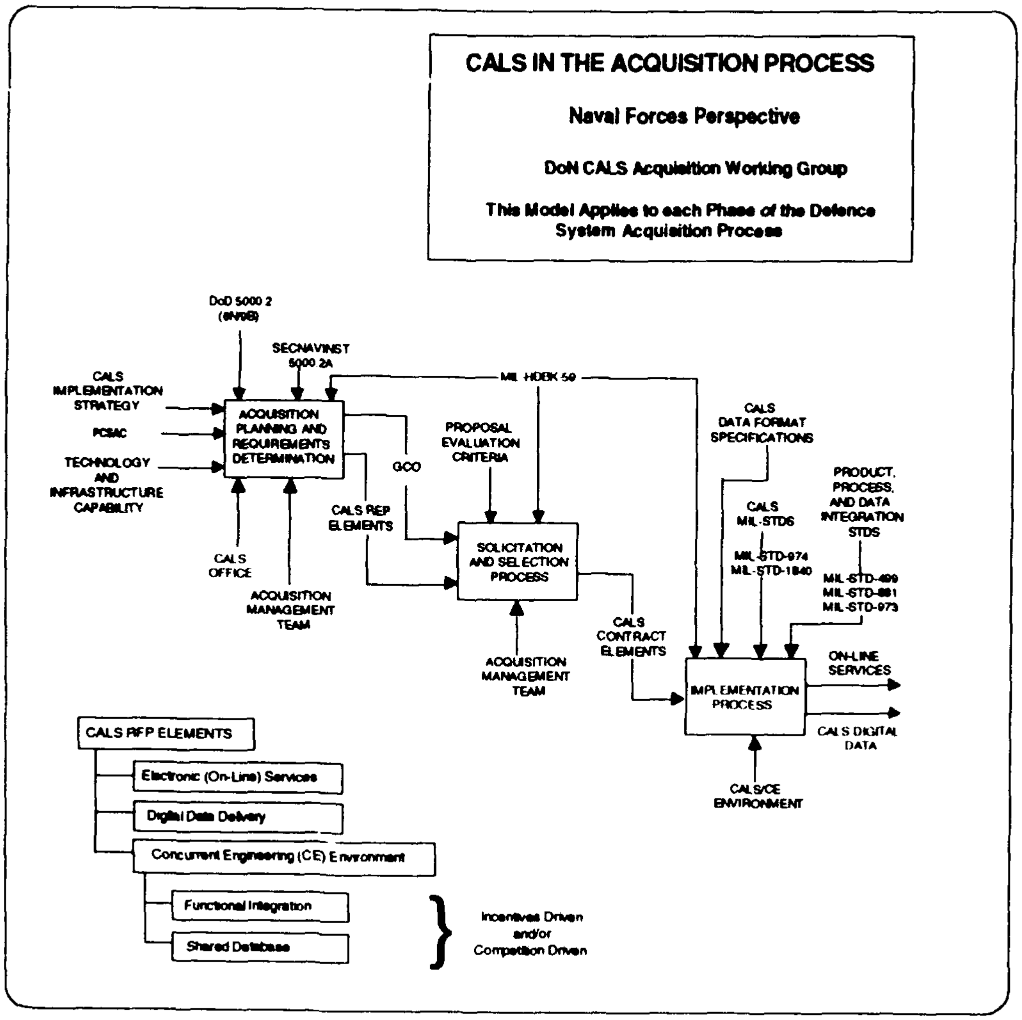
Commanding Officer
NCTAMS LANT
Code N813.2
9456 Fourth Ave Suite 200
Attn: File Library Upgrade
Norfolk, VA 23511-2199

NOTE: Local ADP authority should be contacted for contract vehicle information.

CALS

COMPUTER-AIDED ACQUISITION AND LOGISTIC SUPPORT

APPENDIXES



APPENDIX A

ACRONYMS, DEFINITIONS, AND APPLICABLE DOCUMENTS

SECOND EDITION

30 June 1993

Prepared by:
CALS Resource and Implementation Cooperative (RIC)

Prepared for:
Navy CALS Acquisition/ Implementation Group

ACRONYMS

A-1.0 Acronyms used in the desktop guide.

2-D	2-Dimensional
3-D	3-Dimensional
ADMAPS	Automated Document Management Information and Control System
ADP	Automated Data Processing
AE	Age Exploration
AIM	Advanced Industrial Management
ALPS	Automated Logistics Publishing System
ANSI	American National Standard Institute
AP	Acquisition Plan
APPS	Advanced Planning and Packaging Support
ASCII	American Standards Committee for Information
ASIC	Application-Specific Integrated Circuits
ASME	American Society of Mechanical Engineers
ATIS	Advanced Technical Information System
BCS	Baseline Comparison System
CAC	Contractor's Approach to CALS
CAD/CAM/CAE	Computer-Aided Design/ Computer-Aided Manufacturing/Computer-Aided Engineering
CAD2	Computer-Aided Design (Second Acquisition)
CAE	Computer-Aided Engineering
CALS	Computer-aided Acquisition and Logistics Support
CALS RIC	CALS Resource and Implementation Cooperative
CALSIP	CALS Implementation Plan
CAM	Computer-Aided Manufacturing
CASE	Computer-Aided Software Engineering
CCITT	Consultative Committee for Telephone and Telegraph
CD	Compact Dist
CD-ROM	Compact Disk - Read Only Memory
CDI	Compact Disk Interactive
CDM	Content Data Model
CDNSWC	Carderock Division of the Naval Surface Warfare Center
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CE	Concurrent Engineering
CEIO	CALS Evaluation and Integration Office
CFA	Cognizant Field Activities
CGM	Computer Graphics Metafile
CITIS	Contractor Integrated Technical Information Service
CIVR	Configuration Item Verification Review
CLIN	Contract Line Item Number
CLIP	Configuration and Logistics Information Program
CMA	Configuration Management Agent
COTS	Commercial Off-the-Shelf
CPU	Computer Processing Unit
CSAR	Configuration Status Accounting Reports
CSL	CALS SGML Library
CSR	CALS SGML Registrar

CTN	CALS Test Network
DAP	Document Application Profile
DAT	Digital Auto Tape
DB	Database
DBUF	Defense Business Operating Fund
DDN	Defense Data Network
DED	Data Element Definition
DFARS	Defense Federal Acquisition Regulation Supplement
DID	Data Item Description
DLA	Defense Logistic Agency
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DoN	Department of Navy
DOS	Disk Operating System
DPI	Dots Per Inch
DSN	Defense Support Network
DSSSL	Document Style Semantics and Specification Language
DTD	Document Type Definition
DTMB	David Taylor Model Basin
DTP	DeskTop Publishing
DVI	Digital Video Interactive
ECP	Engineering Change Proposal
EDI	Electronic Data Interchange
EDIF	Electronic Data Interchange Format
EDIFACT	EDI for Administration, Commerce, and Transportation
EDMICS	Engineering Data Management Information and Control System
EDPODS	Engineering Drawing Print-On-Demand System
EDS	Electronic Display System
EIA	Electronic Industries Association
ELIN	Exhibit Line Item Number
EMD	Engineering and Manufacturing Development
EPC	Electronic Publishing Committee
FAR	Federal Acquisition Regulation
FAX	Faximile
FCIM	Flexible Computer Integrated Manufacturing
FCS	Finite Coordinate Space
FIPS	Federal Information Processing Standard
FMECA	Failure Modes and Effects Criticality Analysis
FOSI	Formatting Output Specification Instance
FPGA	Field-Programmable Gate Arrays
FRC	Final Reproducible Copy
G-byte	Gigabyte
GCA	Graphic Communication Association
GCO	Government Concept of Operations
GFI	Government-Furnished Information
GIDEP	Government-Industry Data Exchange Program
GOSIP	Government Open System Interconnection Profile
HW	Hardware
HW/SW	Hardware/Software
IAW	In Accordance With

IEEE	Institute of Electrical and Electronic Engineers
IETM	Interactive Electronic Technical Manuals
IGES	Initial Graphics Exchange Specification
ILS	Integrated Logistics Support
ILSP	Integrated Logistics Support Plan
IMIS	Integrated Maintenance Information System
IPC	Institute for Interconnecting and Packaging
IPO	IGES/PDES Organization
ISAC	Issues Screening and Analysis Committee
ISG	Industry Steering Group
ISO	International Organization for Standardization
ISWG	Industry Standards Working Group
ITO	Instructions To Offers
IWSDB	Integrated Weapon Systems Data Base
JCALS	Joint CALS
JCMO	Joint CALS Management Office
JEDMICS	Joint Engineering Data Management Information and Control System
LAN	Local Area Network
LCC	Life Cost Cycle
LEM	Logistic Element Managers
LLNL	Lawrence Livermore National Laboratory
LLTIL	Long Lead Time Items List
LOGPARS	LOGistics Planning And Requirements Simplification
LORA	Level of Repair Analysis
LRU	Line Replacement Unit
LSA	Logistic Support Analysis
LSAP	Logical Support Analysis Plan
LSAR	Logistic Support Analysis Record
MACS	Mutually Agreeable Commercial Software
MEDALS	DoD Military Engineering Drawing Asset Locator System
MIS	Management Information System
MPT	Manpower, Personnel, Training
MRSA	Material Readiness Support Activity
NADC	Naval Air Development Center
NATSF	Naval Aviation Technical Services Facility
NAVAIR	Naval Air Systems Command Headquarters
NAVNET	Navy Network
NAVSEA	Naval Sea Systems Command Headquarters
NAWC	Naval Air Warfare Center
NC	Numerical Control
NCGA	National Computer Graphics Association
NDI	Non-Developmental Items
NEDALS	Navy Engineering Drawing Asset Locator System
NFS	Network File System
NIDDESC	Navy Industry Digital Data Exchange Standards Committee
NIFF	Navy Image File Format
NIMP	Navy Infrastructure Modernization Program
NIST	National Institute of Standards and Technology
NPFC	Naval Publications and Forms Center
NPPS	Navy Publishing and Printing Service
NTP	Navy Training Plan

NWC	Naval Weapons Center
NWS	Naval Weapons Station
O&S	Operational & Support
OCR	Optical Character Recognition
ODA	Open Document Architecture
ODIF	Office Document Interchange Format
OS	Output Specification
OSD	Office of the Secretary of Defense
OSI	Open Systems Interconnection
PC	Personal Computer
PCA	Physical Configuration Audit
PCB	Printed Circuit Board
PDES	Product Data Exchange using STEP
PDL	Page Description Data
PDR	Preliminary Design Review
PHS&T	Packaging, Handling, Stowage, & Transportation
PLD	Programmable Logic Design
PMA	Portable Maintenance Aid
PMS	Planned Maintenance System
PMTC	Pacific Missile Test Center
POSIX	Portable Operating System Interface
PWB	Printed Wiring Board
QAPP	Quality Assurance Program Plan
QIC	Quarter Inch Cartridge
QSTR	Quick Short Test Reports
R&M	Reliability and Maintainability
RAMP	Rapid Acquisition of Manufactured Parts
RCM	Reliability Center Maintenance
RDT & E	Research, Development, Test and Evaluation
RFD	Request for Deviation
RFP	Request For Proposal
RFQ	Request for Quotes
RFW	Request for Waiver
RISC	Reduced Instruction Set Computing
ROM	Read Only Memory
SAP	Site Activity Plan
SCLSIS	Ship Configuration and Logistic Support Information Service
SDIF	SGML Document Interchange Format
SDR	System or Software Design Review
SE	Support Equipment
SEMP	System Engineering Management Plan
SERD	Support Equipment Recommendation Data
SGML	Standard Generalized Markup Language
SIE	Special Inspection Equipment
SIG	Special Interest Group
SNAP	Shipboard Nontechnical ADP Program
SOW	Statement of Work
SPA	Solicitation Package Automat[illegible]
SPAWAR	Space & Navy Warfare System Command
SPCC	Ship Parts Control Center
SPDL	Standard Page Description Language

SQL	Standard Query Language
SSAP	Site Support Activity Plan
STEP	Standard for the Exchange of Product Data System
SW	Software
T&E	Test and Evaluation
TCP/IP	Transmission Control Protocol/Internet Protocol
TDP	Technical Data Package
TEMP	Test and Evaluation Master Plan
TI	Technical Information
TIF	Technical Information File
TM	Technical Manual
TMCR	TM Contract Requirement
TMM	Technical Manual Manager
TMPODS	TM Print-On-Demand System
TO	Technical Order
TQM	Total Quality Management
TTG	Tiling Task Group
UHDL	UHSIC Hardware Description Language
UHSIC	Ultra High Speed Integrated Circuits
USAMC	United States of America Marine Corp.
VASG	VHDL Analysis Standardization Group
VHDL	VHSIC Hardware Description Language
VHSIC	Very High Speed Integrated Circuit
WAN	Wide Area Network
WBS	Work Breakdown Structure
WORM	Write Once/Read Many times
WRA	Weapon Replaceable Assembly

DEFINITIONS

A-2.0 The following terminology has become common in the CALS environment in reference to data deliverables:

AEGIS is the combat and weapon system designed for use on the US Navy's CG 47 class of guided missile cruisers and the DDG 51 class of guided missile destroyers.

Associated List is a tabulation of pertinent information related to an item depicted on a drawing .

CGM or Computer Graphics Metafile is a digital data file containing graphic information in a file format compatible with most other graphic systems.

CITIS (Contractor Integrated Technical Information Service) is a contractor developed service which provides electronic access to and/or delivery of contractually required Contract Data Requirements List (CDRL) data to users. CITIS, and consequently the contract provisions for CITIS, does not include the databases to which access is granted, or the database process, or the format of data to be accessed through CITIS.

Data Presentation Format is the human interpretation of data such as text layout, drawing scale, level of detail, or part orientation.

Digital Data Format is the structure of the data on the physical transfer media such as IGES, CGM, SGML, and CCITT Group 4 Raster.

Digital Data is data represented in computer-generated, binary form.

Document applies to the information content of a variety of different printed or digital entities that contain technical information. These entities may be technical reports, analyses, drawings, specifications, lists, engineering change notices, or a large variety of other information.

Drawing Format is the arrangement and organization of information within a drawing. This includes such features as the size and arrangement of blocks, notes, lists, revision information, and use of optional or supplemental blocks.

EDI (Electronical Data Interchange) is data that is transmitted or communicated electronically according to established rules and formats. The fomatted data may be transmitted from originator to recipient via telecommunications or physically transported on electronic storage media.

End-product (End-item) is an item, either an individual part or assembly, in its final or completed state.

Engineering Data are engineering documents such as drawings, associated lists, accompanying documents; specifications, and standards, or other information prepared by a design activity and relating to the design, manufacture, procurement, test, or inspection of manufactured items.

Engineering Drawings are documents that disclose directly or by reference, by means of graphic and textual information, the physical and functional end-product requirements of an item. Geometry, material requirements, and process data, along with notational explanations pertaining to specific functions and features of the depiction, are its typical contents.

Final Deliverables are any item or items specified for delivery under the contract to mark the completion or fulfillment of a required task or tasks.

IETM or Interactive Electronic Technical Manual is a computer-based collection of information needed for the diagnosis and maintenance of a weapons system, optically arranged and formatted for interactive presentation to the end user on an electronic display system.

IGES or Initial Graphics Exchange Specification is a neutral file format for the representation and transfer of product definition data among CAD/CAM systems and application programs.

ILS or Integrated Logistics Support is a disciplined, unified, and iterative approach to the management and technical activities necessary to integrate support considerations into system and equipment design; develop support requirements that are related consistently to readiness objectives, to design, and to each other; acquire the required support; and provide the required support during the operational phase at minimum cost.

ILS Data is the technical information to support the ILS management process.

Intelligent or Product Data adds the elements of life-cycle support to the elements found in product definition data. [Ref. Appendix B, Intelligent (Product) Data]

Interim Deliverables are any item or items delivered under the contract that are not specifically required by the contract, but may include draft forms of final deliverables.

Legacy Data is technical data (ILS Data, engineering drawings, LSAR, etc.) that was developed and archived before the implementation of CALS initiatives.

LSA or Logistic Support Analysis is the selective application of scientific and engineering efforts undertaken during the acquisition process, as part of the systems engineering process, to assist in: Causing support considerations to influence design; defining support requirements that are related optimally to design and to each other; acquiring the required support; and providing the required support during the operational phase at minimum cost.

LSAR or LSA Record is a set of data elements formatted in either flat file or relation table that is comprised of ILS technical data used to satisfy support acquisition.

PDES/STEP or Product Data Exchange using STEP/Standard for the Exchange of Product Model Data are standards and specifications under development for communicating a complete product model with sufficient information content so as to be interpretable directly by advanced CAD/CAM applications such as generative process planning, CAD-directed inspection, and automatic generation and verification

of automated manufacturing data. PDES is being developed as a national standard, and STEP is being developed as the international counterpart. STEP is the international standards effort (officially entitled ISO 10303) to develop a neutral mechanism capable of completely representing product data throughout the life cycle of the product.

Product Definition Data denotes the totality of data elements required to completely define a product. Product definition data includes geometry, topology, relationship, tolerances, attributes, and features necessary to completely define a component part or an assembly of parts for the purpose of design, analysis, manufacture, test, and inspection.

Product Drawings are engineering drawings that provide the necessary design, engineering, manufacturing, and quality support information necessary to permit a competent manufacturer to produce an interchangeable item that duplicates the physical and performance characteristics of the original design without additional design engineering or recourse to the original manufacturer.

Raster data is a binary representation of an image. There are two types of raster data, tiled and untiled. Untiled raster data has no document architecture and is represented by a single compressed data entity. Tiled raster data resembles a two-dimensional grid with each tile or set of pixels representing a portion of the image.

Technical Data Package is a technical description of an item consisting of all applicable technical data such as drawings and associated lists, specifications, standards, performance requirements, quality assurance requirements, and packaging details necessary to define the design configuration and procedures required to ensure item performance.

Technical Manuals are any technical publication or other form of documentation used to install, operate, maintain, test, repair, or overhaul weapon systems and support equipment or to provide logistic support of ships, aircraft, weapon systems, or defense material. Technical manual information may be presented or delivered in any form including, but not limited to, hard copy, audio and visual displays, magnetic tape, discs, and other electronic devices.

TMCR or Technical Manual Contract Requirement is a definitive contractual document that provides the complete content and format requirements for the preparation and delivery of one or more technical manuals and technical manual management data items. The TMCR consolidates the requirements from various Government specifications and standards and tailors those requirements to produce a technical manual that satisfies specified user needs.

Transfer Media Format is the physical form of the data deliverable such as paper, microfilm, magnetic tape, or optical disk.

Validation is the comprehensive testing of information, data, and procedures contained in a technical manual. This testing is accomplished by review/comparison of nonprocedural material against up-to-date source data and by actual performance of procedures on the system or equipment for which the manual was written by the TM preparing activity.

Vector data is the representation of an image as a sequence of line segments. Vector data provides geometrical and physical representation of objects in both two and three dimensions.

Verification is Government testing in an operational environment of the accuracy, adequacy, and suitability for use of a technical manual prior to final acceptance.

APPLICABLE DOCUMENTS

A-3.0 The following documents contain important information governing ILS or LSA, TDPs, and technical manuals. They also contain various CALS applications concerning the creation, management and use of ILS or LSA, TDPs, and technical manuals. This document will attempt to reference the documents listed below where applicable and suggest further review where appropriate. A majority of the information contained in the following discussions has come directly from the documents being discussed.

A-3.1 DoDI 5000.2, *Defense Acquisition Management Policies and Procedures (Part 7, Logistics and Other Infrastructure)*

A-3.1.1 Scope and Purpose

The policies and procedures in this directive establish the basis for ensuring that support considerations are effectively integrated into the system design. It ensures that required support structure elements are acquired concurrently with the system so that the system will be supportable and supported when fielded.

A-3.1.2 CALS Intent

The integrated nature of a logistics support approach such as this touches on all aspects of system planning, design, acquisition, and operation. The fact that concurrent and iterative development of the logistics aspects is desired makes the application of a CALS environment more desirable. Much of the ten aspects of logistics support detailed in this document lends itself to digital acquisition and application.

A-3.1.3 Relevance

All of the data generated by this effort can be considered a component part of ILS data. Included in this part are Logistics Support Analysis and the required LSAR effort that goes with it. Emphasis is on support for the total life cycle of the system being studied.

A-3.2 MIL-HDBK-59, *CALS Program Implementation Guide*

A-3.2.1 Scope and Purpose

The purpose of this handbook is to provide detailed application information and guidance to personnel responsible for the acquisition and use of weapons system technical data for contractually implementing CALS requirements in weapons system and related major equipment procurements. Its purpose is to assist Acquisition Managers in transitioning from paper-intensive processes to digital data delivery and access. It also supports the structuring of contract requirements to achieve integration of automated capabilities for design, manufacturing, and logistics support.

This handbook describes functional requirements and technical standards applicable to all programs for acquisition and support of weapons systems and related major equipment items to which Department of Defense Directive (DoDD) 5000.1 or Department of Defense Instruction (DoDI) 5000.2 apply. It also is applicable for systems and items for which the acquisition of technical data in digital form is required in accordance with MIL-STD-1840, MIL-STD-1388-1/2, and supporting military

specifications. This handbook also addresses those specific functional capabilities requiring integration by the contractor to support weapons system acquisition. The scope of this handbook continues to increase as CALS strategies are refined, methodologies for implementation are developed, and new material for inclusion is received from Government and industry.

A-3.2.2 CALS Intent

Requirements issued through the Federal Acquisition Regulations (FARs) on 3 October 1989 and a DoD FAR Supplement states that an Acquisition Manager must describe the extent of CALS implementation in approved weapons system acquisition plans. Policy guidance issued by DoD requires that plans for new weapons systems and related major equipment items include use of the CALS standards. This handbook provides detailed information on the application of these CALS requirements to weapons system and major equipment procurements. The use of MIL-HDBK-59, which provides information and guidance to personnel responsible for the acquisition and use of weapons system technical data, is the CALS implementation specification for digital data acquisition. The MIL-HDBK-59 purpose is to assist in the transition from paper-intensive processes to digital data delivery and access.

A-3.3.3 Relevance

A primary CALS thrust is automation and integration of the generation, delivery, and use of weapons system technical support data over the weapons systems life cycle. This data includes, among other things, all the technical support information provided and generated by the ILS and LSA process, engineer drawings and product data used in design and manufacturing, and technical manuals primarily used to support weapon systems.

A-3.3 MIL-M-29532(EC), ***Master Library Data Elements for Technical Publications***

A-3.3.1 Scope and Purpose

This specification provides a uniform set of data elements necessary to track and control information in Navy technical publications at the master library level. It provides a schema to index technical publications and to interchange indexed technical publications among contractors, Navy technical data repositories, and the Navy user community. This specification is applicable to technical publications, which have either been converted to digital format through scanning of existing hard copy publications or created directly on an automated document processing system (word processor or authoring system). This specification defines a logical file structure that will permit interchange by magnetic tape, diskette, or optical disk media. The basic requirement is that the interchange medium support a file structure. Presently, MIL-STD-1840 is limited to interchange by magnetic tape.

A-3.3.2 CALS Intent

Acquisition Managers should seek improved methods and procedures for indexing, tracking, and controlling information relating to technical manuals. This indexing is necessary for access to appropriate page images without requiring a sequential visual

search from the beginning of the file. Other computer-sensible encoding techniques, such as SGML, can be considered self-indexed and do not require a separate index.

A-3.3.3 Relevance to Technical Manuals

The indexing methods described in MIL-M-29532(EC) provide a way of controlling previously unindexed digital files of technical publications and may be applied to technical manuals that have been encoded as digital image files, often in raster format via scanning of existing documents. Other computer-sensible encoding techniques, such as SGML, can be considered self indexed, but this indexing provides a concise index for the interchange of technical information.

A-3.4 MIL-M-38784, *Manuals, Technical: General Style and Format Requirements*

A-3.4.1 Scope and Purpose

This specification prescribes the general style and format requirements for preparing a technical manual. This includes all technical documents that are assigned a technical manual identification number and are to be controlled by a technical manual management information system or those that are subject to requisition from an inventory control point. This document provides for the delivery of technical manuals in both paper and digital forms. Three types of technical manuals are addressed by this specification: Review Draft Copy (RDC); Preliminary Technical Manuals (PTMs); and Final Reproducible Copy (FRC).

A-3.4.2 CALS Intent

DoDD 5000.2 states that technical data (including technical manuals) will be prepared, delivered, and used in digital form unless it is not cost-effective for the Government. In addition, maximum use should be made of available contractor-automated databases. MIL-M-38784, Appendixes B and C, provide for electronic delivery of technical manuals through use of a Document Type Definition (DTD) as defined in MIL-M-28001.

A-3.4.3 Relevance to Technical Manuals

This standard addresses the style, format, quality assurance (QA) provisions, and preparation for delivery of that technical data in accordance with both CALS and non-CALS standards. It supplements various technical content specifications (MIL-M-15071) for certain types of TMs and does not alone define delivery of any technical data.

A-3.5 MIL-SPEC-28000 Series

The MIL-SPEC-28000 Series provides implementation-specific guidance for preparation of textual and graphic data files for technical publications or product data interchange. These standards are relevant for the preparation of files that are used in MIL-STD-1840 but can also serve many other data transfer and neutral language format purposes. This set of standards defines how technical data is to be represented digitally in a number of different formats.

A-3.5.1 MIL-D-28000, *Digital Representation for Communication of Product Data: IGES Application Subsets*

Scope and Purpose

MIL-D-28000 defines a standard for Illustration Data File formats in technical publications and for product data consisting of engineering and system support data. This specification identifies the requirements to be met when product definition data is delivered in the digital format of the Initial Graphics Exchange Specification (IGES) as specified by its American National standard, ANSI Y14.26M.

A-3.5.2 MIL-M-28001, Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text [Standard Generalized Markup Language (SGML)]

Scope and Purpose

MIL-M-28001 defines a standard for preparation of textual information for technical publications. SGML is a textual mark-up language that is formatted by various DTDs and FOSIs that define the format and structure of the textual output. DTDs should conform to the appropriate presentation specifications required for the specific technical data requested. Additionally, graphics can be incorporated indirectly into the document with the use of pointers that refer to the separate graphic files. Data prepared in conformance to these requirements will facilitate the automated storage, retrieval, interchange, and processing of technical documents from heterogeneous sources.

A-3.5.3 MIL-R-28002, *Requirements for Raster Graphics Representation in Binary Format*

Scope and Purpose

MIL-R-28002 defines a standard for representation of binary image files for technical publications that may contain both textual and/or product illustration data. There are two forms of raster data specified, formatted and unformatted. Formatted data is the only acceptable form for technical data and may be either tiled or untiled. However, tiled is the only form acceptable for illustration data used in technical publications, reports, and engineer drawings.

A-3.5.4 MIL-D-28003, *Digital Representation for Communication of Illustration Data: CGM Application Profile*

Scope and Purpose

MIL-D-28003 defines a standard to be met when two-dimensional picture descriptions or illustration data that is predominantly vector-oriented is delivered in the digital format of the Computer Graphics Metafile (CGM).

A-3.5.5 CALS Intent

These specifications are the actual format specifications for the digital data interchange of textual and/or illustration/engineering drawing information. These specifications

originated as ISO standards before the creation of the CALS concept, and they provide the basic forms of data interchange through neutral file formats. These basic components will play a large part in more encompassing CALS standards such as MIL-C-CITIS, which will be the implementation of the CALS infrastructure.

A-3.5.6 Relevance

This set of specifications defines how technical data, including TDPs, is to be represented digitally in a number of different formats. MIL-R-28002, raster, uses binary tiles and MIL-D-28003, CGM, uses two-dimensional vectors to represent a scanned image that may contain both textual and/or product illustration data. MIL-D-28000, IGES, is unique because it integrates geometric location, nongeometric attributes, text and annotation, and data relationships into a meaningful engineering drawing representation. MIL-M-28001, SGML, is a textual mark-up language that can be used for text processing of any drawing text, lists, annotations, and documentation associated with a technical data package. SGML-marked text can be formatted according to various DTDs and FOSIs that define the format and structure of the textual output. DTDs should conform to the appropriate presentation specifications required for the specific technical data requested.

A-3.6 MIL-STD-100, *Engineering Drawing Practices*

A-3.6.1 Scope and Purpose

This standard prescribes general requirements for the preparation and revision of engineering drawings and associated lists prepared by or for the departments and agencies of the DoD. This standard provides all the information necessary for engineering drawings to be created and revised according to standard procedures and practices. This standard provides:

- Standard drawing practices for preparation of engineering drawings and drawing format materials
- Requirements for drawings derived from or maintained by Computer Aided Design (CAD)
- Definitions and examples of types of engineering drawings to be prepared for the DoD
- Procedures for the creation of titles for engineering drawings,
- Numbering, coding, and identification procedures for engineering drawings, associated lists, and documents referenced on these engineering drawing and associated lists
- Locations for marking an engineering drawing
- Requirements for preparation of associated lists
- Methods for revision of engineering drawings and methods for recording of such revisions.

A-3.6.2 CALS Intent

This document was created to standardize the presentation format of engineering drawings to be used throughout the DoD. Either paper or digital format engineering drawings will continue to be the most proper way to disclose, by means of pictorial or textural presentations, the physical requirements of an end-product. This being the case, CALS standards and the Integrated Weapon Systems Data Base (IWSDB) concept will rely on engineering drawings to relay those end-item physical requirements. Other information defined by MIL-STD-100 for engineering drawings, such as functional and manufacturing requirements and associated parts lists, has begun, in the modern CALS terminology, to be included in electronic engineering drawings through product definition vehicles like IGES (MIL-D-28000) and PDES (MIL-P-28004).

A-3.6.3 Relevance to Technical Data Packages

This standard will continue to define the standard presentation format for all DoD engineering drawings and associated lists in paper or digital format. Since TDPs include engineering drawings as one of its components, this standard directly affects the presentation of the TDPs drawing and graphic elements.

A-3.7 MIL-STD-1388-1A, *Logistic Support Analysis*

A-3.7.1 Scope and Purpose

This standard provides general requirements and task descriptions governing performance of Logistic Support Analysis (LSA) during the life cycle of systems and equipment. This standard contains rationale for the selection and tailoring of the LSA tasks required to meet program objectives in a cost-effective manner.

A-3.7.2 CALS Intent

This standard implements the LSA guidelines and requirements established by DoDI 5000.2, Major System Acquisition Procedures. Maximum use shall be made of digital data products. All newly required LSAR data shall be in conformance to MIL-STD-1388-2B.

A-3.7.3 Relevance

The requirements of this standard are applicable to new system/equipment acquisition programs, major modification programs, and applicable research and development projects. The goal of this standard is a single, uniform approach by the Military Services for conducting those activities necessary to (a) cause supportability requirements to be an integral part of system requirements and design, (b) define support requirements that are optimally related to the design and to each other, (c) define the required support during the operational phase, and (d) prepare attendant data products.

A-3.8 MIL-STD-1388-2A & B, *DoD Requirements for a Logistic Support Analysis Record*

A-3.8.1 Scope and Purpose

This standard prescribes the data element definitions (DED), data field lengths, and formats for LSAR data. It identifies the LSAR reports that are generated from the LSAR data and identifies the LSAR relational tables and ADP specifications for transmittal and delivery of automated LSAR data.

A-3.8.2 CALS Intent

MIL-STD-1388-2B specifically provides for a digital, relational database to maximize the use of integrated data systems tied to engineering, manufacturing, and product support databases as sources of LSA documentation. This standard is directed toward improving the cost-effectiveness of generation, maintenance, acquisition, and use of the technical data required to support an ILS program. The LSAR is intentionally structured to accommodate the maximum range of data potentially required by all services and all ILS element functional areas. CALS requirements for LSAR will be met through the use of an approved LSAR ADP system.

A-3.8.3 Relevance

This standard allows for delivery of LSAR data in manual or automated mode and on-line access to LSAR data as specified by the requiring authority. It does not prescribe which ADP software must be used to process LSAR data. The minimum ADP design requirements that must be adhered to for industry-developed LSAR ADP systems are described in MIL-STD-1388-2, General Requirements.

A-3.9 MIL-STD-1840, *Automated Interchange of Technical Information*

A-3.9.1 Scope and Purpose

MIL-STD-1840 provides an overall instructional approach to the use of the MIL-SPEC-28000 Series for technical data (including ILS data) interchange. The purpose of this document is to standardize the digital interface for the exchange of digital information. The standard currently addresses the interface of computer technologies that are automating the creation, storage, retrieval, and delivery of ILS data, engineering drawings, and other technical information. MIL-STD-1840 defines standard file sets and formats, data file representation standards, header record formats, and file-naming conventions for the transfer of technical information. Such information includes training and maintenance manuals with their associated illustrations; product definition data, such as engineering drawings and specifications; and the evolving product data concept that provides for transfer and archival storage of product information in a form directly usable by computer applications.

A-3.9.2 CALS Intent

With the overall goal of CALS to migrate toward a paperless environment, MIL-STD-1840 orchestrates the use of the MIL-SPEC-28000 Series and is one of the fundamental basic standards for digital data interchange of textural and/or

illustration/engineering drawing information. Once the acquisition of the data has been resolved, it is MIL-STD-1840 that defines the process for the way the technical data is to be transferred. As with the implementation of the Contractor Integrated Technical Information Service (CITIS), the potential exists for substantial quality improvements and reductions in acquisition and support costs through use of the CALS standards due to the elimination of duplicate, manual, error-prone processes. This standard in conjunction with the MIL-SPEC-28000 Series will produce improved responsiveness of the industrial base by development of integrated design and manufacturing capabilities and by industry networks to construct and support systems and equipment based on digital product descriptions.

A-3.9.3 Relevance

This standard defines how technical information, including TDP elements and possibly technical manuals, is to be represented digitally in a number of different formats that are to be used for digital data interchange. MIL-STD-1840 specifies media types and then refers to the MIL-SPEC-28000 Series for detailed format specifications.

A-3.10 MIL-T-31000, *Technical Data Packages*

A-3.10.1 Scope and Purpose

This specification prescribes the requirements for preparing a TDP composed of one or more TDP elements and related TDP management data products. This includes, but is not limited to, TDPs prepared for use in development, procurement, production, installation, maintenance, provisioning, transportation, configuration management and mobilization. Selection of the TDP elements and TDP data management products must be based on the degree of design disclosure required to support the acquisition and life-cycle support strategies for the product being documented.

This specification covers the following elements of TDPs and TDP management data products:

TDP Elements:

- Conceptual design drawings and associated lists
- Developmental design drawings and associated lists
- Product drawings and associated lists
- Commercial drawings and associated lists
- Special inspection equipment (SIE) drawings and associated lists
- SIE operating instructions
- SIE calibration procedures
- SIE descriptive documentation
- Special tooling drawings and associated lists
- Specifications
- Preservation, packaging, packing, and marking data
- Software documentation
- Test requirements documents
- TDP document list
- Certification data sheet

TDP Management Data Products:

- Source control drawing approval request
- Drawing number assignment report
- Proposed critical manufacturing process description
- TDP quality control program plan
- TDP validation report
- Quality engineering planning list
- Engineering release record

A-3.10.2 CALS Intent

MIL-T-31000 provides CALS-implementation guidance for acquiring data products in digital form by referencing DoD Policy and the CALS Program Implementation Guide. DoD Directive 5000.2 states that technical data (including engineering drawings) will be prepared, delivered, and used in digital form unless it is not cost-effective for the Government. In addition, maximum use should be made of available contractor-automated databases. The use of MIL-HDBK-59, which provides information and guidance to personnel responsible for the acquisition and use of defense system technical data, is called for in MIL-T-31000 as the CALS-implementation handbook for digital data delivery and access.

A-3.10.3 Relevance to Technical Data Packages

See A-3.10.1, *Scope and Purpose.*

APPENDIX B

PRODUCT DATA

SECOND EDITION

30 June 1993

Prepared by:
CALS Resource and
Implementation Cooperative (RIC)

Prepared for:
Navy CALS Acquisition/
Implementation Group

B-1.0 Intelligent (Product) Data

Product data are the totality of data elements required to completely define a product throughout its entire life cycle. Engineering drawings make up a very small portion of product data and provide only the human interpretable information for a system. Standards are currently being developed to define more completely this form of product data.

- VHSIC hardware description language
- Electronic Design Interchange Format (EDIF)
- Native CAD format
- Gerber data

B-2.0 Advantages and Disadvantages

Product data are the most comprehensive form of digital data. Product data contain all information needed to completely describe a product, and a large portion of this information can be directly interpreted by a computer. This capability provides several advantages. Product data allow the simulation of systems modifications prior to implementation and evaluation of form, fit, and function performance of components. In addition, product data, with its inherent intelligence, can be used to drive manufacturing processes. A distinct disadvantage of product data is that this intelligence is not transferable to other data deliverable options. The creation of engineering drawings invokes a presentation format in which much, if not all, the intelligence of the product data is lost. In addition, product data are more conceptual than real. Product data are also the most expensive data deliverable option.

B-3.0 Life Cycle Considerations

Delivery of product data is generally not cost effective during the early stages of a weapons system program's life cycle. The advantages of intelligent data are not fully utilized early in the life cycle due to the typical use of the data, which is usually "view only." However, during the Engineering and Manufacturing Development (EMD) phase, intelligent product data may be useful because all other data deliverable options can be created from this type of data. In addition, intelligent data will support design changes and system modifications throughout the production and deployment phase of a weapons system program.

B-4.0 Infrastructure

Product data require a powerful computer environment with the appropriate CAD hardware and software to invoke it. The environment created by product data has the capability to produce all other forms of digital and nondigital data.

B-5.0 Validation and Verification

Product data provide inherent means for validation and verification because it contains relationship information about the various components that make up the product being described. It is envisioned, and in some cases a reality, that applications, such as simulators, can be used on the data to not only verify conformance to the digital data standard but also to validate the technical content per contractual requirements.

B-6.0 Contract Language

In order to invoke this data deliverable option, specific CDRLs must be developed for each unique data format and CAD system for which data is required. The following sample CDRLs specify Gerber data, which are useful in certain manufacturing environments, and also additional sample CDRLs of product data deliverables. The information contained in these contract vehicles should be tailored to meet the requirements of the specific weapons system program.

CONTRACT DATA REQUIREMENTS LIST
(Data Item)

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 110 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503. Please DO NOT RETURN your form to either of these addresses. Send completed form to the Government Issuing Contracting Officer for the Contract/PR No. listed in Block E.

A. CONTRACT LINE ITEM NO.

B. EXHIBIT

C. CATEGORY TDP _X_ TM ____ OTHER ______

D. SYSTEM/ITEM

E. CONTRACT/PR NO.

F. CONTRACTOR

1. DATA ITEM NO.

2. TITLE OF DATA ITEM: PRODUCT DRAWINGS AND ASSOCIATED LISTS

3. SUBTITLE: MASTER GERBER TAPE FOR CAD SYSTEM

4. AUTHORITY (Data Acquisition Document No.): SEE BLK 16

5. CONTRACT REFERENCE

6. REQUIRING OFFICE

7. DD 250 REQ: DD

8. APP CODE: A

9. DIST STATEMENT REQUIRED: SEE BLK 16

10. FREQUENCY

11. AS OF DATE

12. DATE OF FIRST SUBMISSION

13. DATE OF SUBSEQUENT SUBMISSION

14. DISTRIBUTION

a. ADDRESSEE	b. COPIES Draft	Final Reg	Final Repro
15. TOTAL			

16. REMARKS

BLKS 4 & 8: DI-DRPR-8100 AND DD FORM 2554-1. PHOTOTOOL EXCHANGE SHALL BE PROVIDED ON 9-TRACK, 1600 BPI MAGNETIC TAPE IN GERBER FORMAT IAW ANSI/EIA RS-274 STANDARDIZED INTERCHANGE FORMAT AND FUNCTIONS. TAPE SHALL INTERFACE WITH (ADDAPPLICABLE CAD SYSTEM).

BLK 9: TECHNICAL DATA SHALL BE MARKED IAW MIL-STD-1806. THE FOLLOWING DISTRIBUTION STATEMENT SHALL APPLY. DISTRIBUTION STATEMENT D: DISTRIBUTION AUTHORIZED TO DoD AND DoD CONTRACTORS ONLY: (ADD REASON), (ADD DATE). OTHER REQUESTS SHALL BE REFERRED TO (ADD CODE).

NOTE: SEE GENERAL DD FORM 1423 GLOSSARY (SEE APPENDIX C) FOR INSTRUCTIONS ON COMPLETING THIS FORM. (COMPLETE DD FORM 2554-1 AND ATTACH TO THIS DD FORM 1423-1). SEE MIL-T-31000 FOR INSTRUCTIONS ON COMPLETING DD FORM 2554-1.

G. PREPARED BY

H. DATE

I. APPROVED BY

J. DATE

DD FORM 1423-1, JUN 90
S/N 0102-LF-010-3500

CONTRACT DATA REQUIREMENTS LIST (Data Item)	Form Approved OMB No. 0704-0188

[illegible]

A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY TDP __X__ TM _____ OTHER __________

D. SYSTEM/ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR

1. DATA ITEM NO.	2. TITLE OF DATA ITEM	3. SUBTITLE
	PRODUCT DRAWINGS AND ASSOCIATED LISTS	TRIAL GERBER TAPE FOR CAD SYSTEM

4. AUTHORITY (Data Acquisition Document No.)	5. CONTRACT REFERENCE	6. REQUIRING OFFICE
SEE BLK 16		

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION	14. DISTRIBUTION
DD	SEE BLK 16			
8. APP CODE		11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION	
A				

a. ADDRESSEE	b. COPIES: Draft	Final: Reg	Final: Repro
15. TOTAL			

16. REMARKS

BLK 4: DI-DRPR-81000 AND DD FORM 2554-1. TRIAL GERBER TAPE SHALL MEET ALL THE REQUIREMENTS OF THE MASTER GERBER TAPE, ELIN (ADD DATA ITEM NO.).

BLK 8: APPROVAL WILL BE FOR REQUIREMENTS LISTED IN ELIN (ADD DATA ITEM NO.). (ADD TIME REQUIRED FOR GOVERNMENT APPROVAL AND TURNAROUND TIME FOR CONTRACTOR TO RESUBMIT DATA TO GOVERNMENT.)

BLK 9: SEE ELIN (ADD DATA ITEM NO.) FOR DISTRIBUTION STATEMENT.

NOTE: SEE GENERAL DD FORM 1423 GLOSSARY (SEE APPENDIX C) FOR INSTRUCTIONS ON COMPLETING THIS FORM.

G. PREPARED BY	H. DATE	I. APPROVED BY	J. DATE

DD FORM 1423-1, JUN 90
S/N 0102-LF-010-3000

APPENDIX C

NAVY INFRASTRUCTURE MODERNIZATION PROGRAMS AND OTHER PROGRAMS UTILIZED FOR TDPs, TM, & LSA DATA

SECOND EDITION

30 June 1993

Prepared by:
CALS Resource and Implementation Cooperative (RIC)

Prepared for:
Navy CALS Acquisition/ Implementation Group

C-1.0 The Navy infrastructure modernization programs and other programs utilized to aid in the creation, management, and use of technical data packages are:

- Computer-Aided Design (Second Acquisition) (CAD2)
- Joint Engineering Data Management Information and Control System (JEDMICS)
- Navy Engineering Drawing Asset Locator System (NEDALS)
- Advanced Industrial Management (AIM)
- Advanced Technical Information System (ATIS).

C-1.1 CAD2

CAD-2 is a major, shore-based infrastructure enhancement initiative to drastically improve and more fully automate all design, development, and engineering activities accomplished by the Navy during the acquisition, production, and support of military defense systems. This CALS program involves computer hardware and software for design, analysis, modeling, simulation, documentation, data transfer, and data management, as well as the necessary technical services for maximize utility of these tools for the Navy.

The CAD-2 program provides the necessary off-the-shelf equipment, software, and support services to replace time consuming manual drafting and obsolete CAD/CAM/CAE capabilities with modern computer-assisted technology. This concept also enhances the interoperability capabilities of the engineering community, Navy, DoD, and contractors. This system will be employed to create, manage, and use engineering analysis data, engineering drawings, technical reports, technical manuals, technical orders, bid packages, manufacturing data, product models, and work packages.

C-1.2 JEDMICS

JEDMICS provides a standard digital system for storage, retrieval, reproduction, and distribution of engineering drawings and related technical data to support defense system maintenance, reprocurement of spares, engineering, training, manufacturing, and logistics support. Engineering Drawing Print-On-Demand System (EDPODS) provides stand-alone production printing capability from a JEDMICS database.

C-1.3 NEDALS

NEDALS is an automated index and ordering system for all Navy-engineering drawings. It provides continuous on-line access to Navy engineering drawing information. NEDALS is the point of entry for Navy engineering drawing information to transfer to the DoD Military Engineering Data Asset Locator System (MEDALS).

C-1.4 AIM

AIM is a major. Naval shipyard initiative to change the functional process for ship maintenance and repair management by improving the shipyard's ability to plan, estimate, schedule, and execute work. The initiative will modify and streamline current ship alterations and repair processes by installing automated tools to access and use digital technical information. The initiative will also integrate these automated tools with other automated systems and ultimately reconfigure shipyard processes and organizations to capitalize on this integration. There are two modules within AIM, the ATIS module and the Advanced Planning and Packaging Support (APPS) module. The ATIS module is designed to place current and accurate digital tecnnical data in the hands of Naval shipyard personnel by serving as the Navy-standard user presentation system for displaying digital logistic technical data. The APPS module will create work packages from the technical information in ATIS to package and manage shipyard work.

C-1.5 ATIS

ATIS is a delivery system designed to provide shipboard and shipyard users current and accurate digital technical data. In the shipyard environment, ATIS allows engineers to access technical documentation [drawings or technical manuals identified through Ship Configuration and Logistics Support Information System (SCLSIS)] to retrieve data from a digital repository (JEDMICS) or to create technical information files (TIFs) containing repair/planning data. TIFs will then be used to produce task sheets for shipyard industrial personnel.

The shipboard ATIS will provide a standard technical documentation retrieval method for ship's company at a single work station. The ATIS platform will use Shipboard Non-technical ADP Program (SNAP) data as a source for identifying required documentation. Documentation to be available in ATIS includes engineering drawings, technical manuals, preventive maintenance data, and engineering operating and sequencing data. ATIS is also used by other Navy/Marine Corps system commands on similar uses and technical data display purposes.

C-1.6 Document Type Definition (DTD)

A DTD defines the rules of a document's structure and the relationships among the structural elements (i.e. chapters contain sections that contain paragraphs etc.). Rules are determined by an application that apply SGML to the markup of documents of a particular type. A DTD includes a formal specification, expressed in a document type declaration, of the element types, element relationships and attributes, and references that could be represented by markup. It, thereby, defines the vocabulary of the markup for which SGML defines the syntax.

C-1.7 Output Specification (OS) and Formatting Output Specification Instance (FOSI)

An OS is a finite set of style characteristics to convey formatting intent for interchange of technical publications coupled with a mechanism for binding the style characteristics to logical elements in an SGML document type declaration. The OS provides a set of

formatting characteristic values used to rigorously describe composition processing functions to be performed on the elements of a text document to provide the format and style required by MIL-M-38748. The OS uses the syntax of an SGML document type declaration.

A FOSI is an element of the OS that assigns values to the style characteristics for a particular document type declaration. The FOSI uses the syntax of an SGML document instance. The FOSI portions can be tailored or modified to satisfy the format and style requirements cited in the governing specification or in the contract. An objective of the FOSI is to rigorously define the format and style of the document produced from the SGML-tagged text. Together with the markup tags specified in MIL-M-28001, the FOSI provides a basic vocabulary from which changes in output processing statements (macros) can be constructed. FOSI delivered with the document must contain certain values for characteristics of every context in which the tag has a unique formatting requirement.

C-2.0 The Navy infrastructure modernization programs and other programs utilized to aid in the creation, management and use of ILS data and LSAR are:

- LOGistics Planning And Requirements Simplification (LOGPARS)
- Ship Configuration and Logistic Support Information System (SCLSIS)
- Advanced Industrial Management (AIM)
- Configuration and Logistics Information Program (CLIP)
- Solicitation Package Automation (SPA)

An overview of these information management infrastructure programs is provided below.

C-2.1 LOGPARS

LOGPARS is a personal computer-based ILS project management expert system that leads an ILS manager through the thought process necessary to plan and execute an ILS program. LOGPARS incorporates the required policy, lessons learned, and expert experience to produce critical ILS program documentation. The systematic, user-friendly approach LOGPARS offers ensures all considerations are addressed, existing policy is complied with, and the potential for contracting redundant information is eliminated. Products produced by LOGPARS include the ILS Statement of Work (SOW) and accompanying CDRL, an ILS milestone schedule, and a baseline warranty clause.

C-2.2 SCLSIS

SCLSIS is the configuration status accounting system for shipboard hardware. It maintains the master file of hardware configure item identity and the identity of technical and logistics products that are applicable to the hardware items. SCLSIS information will be used to define what digital products need to be assembled into packages for particular functions. Such packaging files will be automatically updated via SCLSIS as configuration changes are made to any ship in the class.

C-2.3 AIM

AIM is a major Naval shipyard initiative to change the functional process for ship maintenance and repair management by improving the shipyard's ability to plan, estimate, and schedule work. There are two modules within AIM. The Advanced Technical Information System (ATIS) module is designed to place current accurate digital technical data in the hands of Naval shipyard personnel. The Advanced Planning and Packaging Support (APPS) module will create work packages from the technical information in ATIS to package and manage shipyard work.

C-2.4 CLIP

CLIP is similar to SCLSIS, as it is also a configuration accounting system program. CLIP supports life-cycle baseline management for both engineering documentation and hardware. It will also track multiple baselines and will establish a functional baseline based on Hierarchical Structure Code by Class. CLIP will also track documents and part number information. Engineering documents, part numbers, and technical manuals are cross-referenced and accessible to the user from a single work station. It allows

local request and retrieval of raster images when "primary" repositories are not available. It complies with MIL-R-28002.

C-2.5 SPA

SPA stores CALS-compliant digital solicitation packages (forms, clauses, technical specifications, and drawings) for print-on-demand output at the two Navy inventory control points (ASO and SPCC).

C-3.0 The Navy infrastructure modernization programs utilized to aid in the creation, management, and use of technical manuals are:

- Automated Logistics Publishing System (ALPS)
- Technical Manual Print-On-Demand System (TMPODS)
- Advanced Technical Information System/Interactive Electronic Technical Manuals (ATIS/IETM)

C-3.1 ALPS

ALPS is a CALS-compliant (ASCII/SGML) publishing system for the acceptance, verification, creation, and updating of technical manuals and other Navy documentation delivered from hardware contractors or authored in-house. Automated Document Management and Publishing System (ADMAPS) is the fourth band (NAVSUP band) of the CAD2 contract, which has been identified for integrated publishing systems. In addition to incorporating ALPS functionality, this contract will provide to Navy Publishing and Printing Service (NPPS) the additional capability to "bridge" the other CAD2 contract bands with JEDMICS by allowing for the conversion to and from the vector format of CAD2 and the raster format of JEDMICS.

C-3.2 TMPODS

TMPODS provides a standard digital system for administration, storage, retrieval, reproduction, conversion of legacy technical data, output on demand (paper/digital), and distribution of CALS-compliant digital files (SGML/raster) for Navy technical manuals. TMPODS will use current supply systems and procedures to interface with SYSCOMS and end users.

C-3.3 ATIS/IETM

ATIS is a delivery system designed to place current and accurate digital technical data into user (shipyard and shipboard) hands. In the shipyard environment, ATIS is an AIM module that allows engineers to access component technical documentation {drawings or technical manuals identified through Ship Configuration and Logistics Support Information System (SCLSIS)}, retrieve it from a digital repository (JEDMICS), and create technical information files (TIFs) containing relevant repair/planning data. TIFs will be used by the APPS module of AIM to produce task sheets for shipyard industrial personnel.

The shipboard ATIS is intended to provide a standard retrieval method for technical documentation for ship's company at a single workstation. The ATIS platform will use Shipboard Nontechnical Automated Data Processing Program (SNAP) data as a source for identifying required documentation. The sailor then retrieves data from optical platters. Documentation to be available in ATIS includes engineering drawings, technical manuals, Planned Maintenance System (PMS) data, and Engineering Operating and Sequencing System (EOSS) data.

IETM is an interactive display system using optimally packaged and formatted technical information for screen presentation of maintenance and diagnostics information.